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NATURE

A WEEKLY JOURNAL OF SCIENCE

"To the solid ground
Of Nature trusts the mind that builds for aye."—WORDSWORTH.

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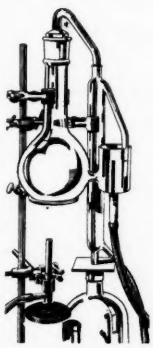

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Forms of application may be obtained from the DIRECTOR and SECRETARY, Science Museum, South Kensington, S.W.7, and the forms when filled in should reach the Director not later than December 21, 1929.

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For continuation of "Officials" see p. ii of Supplement.

NATURE

SATURDAY, DECEMBER 7, 1929.

CONTENTS.

	PAGE
The Nation and Research	865
Enzymes. By Prof. Arthur R. Ling	867
Memorials of Galileo. By Dorothea Waley Singer	869
Sex in Savagery. By Capt. George Pitt-Rivers	870
Our Bookshelf	872
Letters to the Editor:	
Low Atomic Energy Levels for Elements of the Oxygen Group.—Prof. J. C. McLennan, F.R.S., and M. F. Crawford	874
The Grant of Invalid Patents.—Carrol Romer; Dr. Norman R. Campbell; The Writer of the Article	874
The Permeability of Plant Cell Membrane to Sugar.—Prof. R. S. Inamdar and K. V. Varadpande	875
A Lantern Slide Model of the Wave Electron.—Prof. S. R. Milner	876
The Subdivisions of the Order Primates.—Prof. G. Elliot Smith, F.R.S.	876
Lankester's 'Gregarine' from the Eggs of *Thalassema neptuni*.—Prof. D. L. Mackinnon and H. N. Roy	877
Influence of the Para-Foveal Regions on the Foveal Region of the Retina.—Dr. F. W. Edridge-Green	877
Graptolite Centenary.—Prof. W. W. Watts, F.R.S.	877
Recent Reactions between Theory and Experiment. THE RAMAN EFFECT: THE CONSTITUTION OF HYDROGEN GAS. By Sir Ernest Rutherford, O.M., Pres. R.S.	878
Cinchona in the British Empire	881
Obituary:	
Sir Archdall Reid, K.B.E. By J. T. Cunningham	882
News and Views	883
Our Astronomical Column	888
Research Items	889
Anniversary Meeting of the Royal Society	892
Forestry in Kenya Colony	893
Physics in Fuel Problems. By H. J. H.	894
Undulant Fever in England and Wales	894
University and Educational Intelligence	895
Calendar of Patent Records	895
Societies and Academies	896
Official Publications Received	899
Diary of Societies	899

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No. 3136, VOL. 124]

The Nation and Research.[1]

THERE is no need to dot the i's and cross the t's of the remarkable pronouncement on scientific research delivered by Sir Walter Fletcher and quoted extensively in NATURE of Nov. 23. It may be said to have contained nothing new: it may, with equal justice, be said that its whole burden and content was new. In it, a great public official who is also a man of science illuminated every facet of a problem which intimately concerns the future of human life. The revealing beam was not uniformly intense, and wisely so. Aspects exist of which it may be said that a pale and gentle light upon them suffices for the time being.

Candle-power will be needed later, and then there will come into play the same dispassionate scrutiny as science accords to all those appearances which more partial judgments stigmatise ill-proportioned. The time will come. What is new in the masterly treatment which the Norman Lockyer lecturer gave to an urgent topic is the promise it affords that the time will come swiftly. It is not that the intellectual resources of England, nay, of the world, should be reorganised. It is that they are even now being recast by minds of whose effective potency the world has been abundantly assured. What Sir Walter Fletcher demands, and the best scientific opinion is with him, is something perfectly clear and consistent. What he calls the "national habit of thought about science" is not, of course, strictly national. It is a world habit which that taste for mixing the true with the untrue, the wise with the unwise, the noble with the ignoble, the effectual with the ineffectual; that taste for mixing and muddling (which Englishmen prize themselves for priding themselves upon) only accentuates in us. He has attacked this habit trenchantly. With what we must believe to be considerable courage, he has dared even to define the dangers to which the very fruitfulness of science exposes it.

"The State", said Burke, "is a partnership in all science, a partnership in all art, a partnership in every virtue and in all perfection"; and so too Sir Walter Fletcher, "that Government will always be wise that makes the Universities strong and leaves them free".

Here lies the crux of the problem of intellectual reconstruction in England. Here all plans must have their origin, all aims their inspiration, and all discussion its starting-point and its end. Is it

[1] Medical Research: the Tree and the Fruit. By Sir Walter Morley Fletcher. (The Norman Lockyer Lecture, 1929.) Pp. 27. (London: The British Science Guild, 1929.) 1s.

possible to frame such a constitution for the universities of Great Britain, and after Great Britain the world, as will make them strong with the strength not only of great States, but also with the strength of the irresistible power of the human mind, sceptreless, free, uncircumscribed?

The question is born of the times, set before us as an aim of practical politics by one who is at the heart of the problem, secretary to one of those committees of the Privy Council in closest touch with each side of the triangle: the "bitter need of suffering men and women", the "national habit", and the devices of a profession. Of these three, the needs of men are constant; the "national habit", also, is all too constant; only for one profession we may write another and again another until the whole field of science will be comprised. The problem is defined, and with equal clearness, the essentials of reform. Equity demands that "if usefulness is to be measured by prominence and influence in the State" it shall be served accordingly; and usefulness rests upon a condition: that science "be left free to follow the clues to new knowledge as Nature lays them down and not as administrative officers may appoint". The administrative officer has, of course, disguises which it is unnecessary to pierce for the moment.

Here are plain indications of the essentials of future policy, resolving into administration and finance of the universities. No university is, of course, wholly scientific. But if science should be the means of elevating the condition of the rest, the result may be no worse than a displacement of the baser legends of scholarly gentility. Where there is great science, there also is high culture. Every claim to national respect for science is a claim equally for all sincere and disinterested thought.

The expenditure of the universities of England is less than four millions a year. (The cost of the lunatics of England has been eight.) To assess the value of the universities would be impossible. They are creators of values. To allocate to them what they need and can use would be to subtract from the present and the yearly wealth of the country a minute and unnoticable portion. In the old days such a portion was subtracted from the value of crops and given to the Church. The Church was left free under a Board of Commissioners and a Bench of Bishops to manage its affairs, to study and to teach, to accept the gifts of the laity in stones and carving, in money and in kind. At the worst she could sell prayers. Most of the fruits of science, all the richest of them, enrich the world without being in themselves saleable commodities. All that is best in a new fact, a new idea, or a new ideal synthesis, all that is best in science is from the moment of its birth the property of all; and despite the fact that in science doctrine does not exist to confuse and disintegrate, it is the Church and not science that is to-day the superior in status, in emoluments, and in freedom from the dictation of the vain and the ignorant.

Here are, we believe, the materials for reconstruction ready at hand, with every indication that historical experience can afford for correction and improvement. A State department, no. In "The Apple Cart" of Mr. Bernard Shaw, it is King Magnus, not a Minister, who speaks of protecting science from prostitution to the professions. Science is the concern of the State; it must not be the tool of the State even if in that guise its lot would be better than now when it is the hobby of philanthropy and the tool of commerce.

The present position is as absurd as it is intolerable. Private generosity provides scarcely more than a tenth of the income of the universities. Yet it retains effective control. It is for this reason that the "national habit" is even more firmly entrenched within the universities than in the Press and the street; the promises of charters and statutes, insufficient as these are, out of measure imposing in comparison with the meagre performances of the laboratories. Teaching, at the university level, is impossible without research, and probably, though less certainly, research is improved by contact with common needs. But it is not essential that changes immediately apparent in the form or even the personnel of governing bodies are necessary. Small changes of the right kind may go far: it is the sources and the character of the inspiration of policy that stand in need of change. Finance and stability are the clear lines for improvement. For the correction of the "national habit" itself, a people trained in a single science, not alone in the facts and uses of that science, but also in its discipline and method, will at least have received the means of entering fully into the spirit of all science.

We foresee strenuous opposition to the course on which Sir Walter Fletcher has set us, and at the same time we find it hard to envisage a vast army of support. But there is weight of support. The universities, except the greatest of them, are frightened and demoralised, the cross currents of interest baffling. But we reassert our conviction that the address is the beginning of a new era in the life of the country. It sets an urgent practical problem for solution.

Enzymes.

Untersuchungen über Enzyme. Von Richard Willstätter. Band 1. Pp. xvi + 860. Band 2. Pp. xi + 861-1775. (Berlin: Julius Springer, 1928.) 124 gold marks.

IN these two volumes, which are dedicated to Dr. Fritz Haber, there are reprinted the collective memoirs on the subject of enzymes from the school of one of Germany's greatest chemists. The collection comprises more than a hundred and thirty original contributions to the subject, the first eight of which are summaries of our knowledge. The vast number of co-workers whose names are given suggests team work, but if this be so, the greatest homage must be paid to the master mind that directed it.

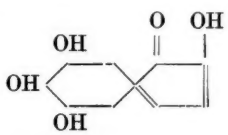
Prof. Willstätter and his school have attacked a chemico-biological problem from the point of view of the pure chemist. Prof. Willstätter may, in fact, be compared with the late Prof. Emil Fischer. His researches, like those of Fischer, have been directed towards unravelling the constitution and structure of naturally occurring substances, and his achievements have not been in vain, for they have shown the physiologist and the biochemist the nature of a series of basal units of substances met with in Nature, and have thus laid the foundation on which attempts may be made to elucidate their physiological function and metabolism in the more complex colloidal state in which they occur in the animal and plant.

It is quite unnecessary to summarise at any length the advancement of our knowledge due to Willstätter's researches: this is well known and was described by Prof. H. E. Armstrong when Willstätter was added to NATURE'S series of "Scientific Worthies" in the issue of July 2, 1927. But in leading up to a short review of his work on enzymes, it will be useful to give a brief historical outline of his earlier work in the sequence in which he has drawn it up in the introductory chapter of this series of papers. The work on chlorophyll having been brought to a provisional conclusion, Willstätter commenced the study of hæmoglobin; in this the remarkable discovery was made that it is possible to obtain from both chlorophyll and hæmoglobin a common derivative, ætioporphyrin. Studies on the colouring matters of petals were then commenced, and these were shown to be the oxonium salts of three closely related substances, pelargonidin, cyanidin, and delphinidin. These studies were, however, brought to a close by the outbreak of the War.

Willstätter's work on enzymes really commenced with the discovery in 1910 of chlorophyllase, an enzyme present in all green leaves. Experiments *in vitro* showed that in alcoholic solution it hydrolyses colloidal chlorophylls into ethyl chlorophyllides and the complicated α-β unsaturated primary alcohol, phytol. The majority of the work on enzymes, however, has been published since the close of the War.

The two volumes are divided into ten sections, the first of which comprises eight papers of the nature of summaries. In this first section the opening paper is the Faraday lecture delivered before the Chemical Society in London in 1927. The other sections are concerned with original researches on the following subjects: Analytical work, adsorption, chlorophyllase, peroxsidase and catalase, sucrase, maltase, lactase, the specificity of enzymes, the lipases and the proteases.

Although, as already stated, Willstätter's work on enzymes commenced in 1910 with the discovery of chlorophyllase, his general study of the subject dates from 1918. Before the various problems could be attacked it was necessary to devise special analytical methods, and a series of papers was published dealing with these. He greatly increased the accuracy of the iodometric method of estimating glucose as well as that of the colorimetric estimation of iron by means of ammonium thiocyanate. Alkalimetric methods of estimating amino acids and peptides, as well as of magnesium and calcium, were also revised. The want was felt of an accurate micro-method of estimating phosphoric acid, and gravimetric and volumetric methods were devised for this purpose in Willstätter's laboratory by R. Kuhn. It was shown that the production of purpurogallin by the action of plant peroxidases and hydrogen peroxide on pyrogallol might be used for the estimation of the enzyme. Incidentally, Willstätter proved that the constitution of purpurogallin is



whilst he accepts A. G. Perkin's view that the constitution of the isomeric purpurogallon is 6 : 7 : 8 trihydroxy α naphthoic acid.

Truly remarkable is Willstätter's work on the different hydrogels of alumina, stannic acids, and silica, and the use to which he put these as adsorbents in the purification of enzyme preparations. According to Michaelis, enzymes exhibit the

phenomenon of kataphoresis and are therefore to be regarded as electrolytes, in most cases amphoteric. Enzymes that are adsorbed by electro-negative kaolin were regarded as more basic, whilst those adsorbed by electro-positive alumina were regarded as more acidic. Thus sucrase was believed to be acidic and trypsin amphoteric. The Willstätter school finds, however, that these results are not valid for the enzymes themselves but only for associated foreign impurities. For example, sucrase in the crude state is not adsorbed by electro-negative kaolin, whilst in a state of greater purity it is readily adsorbed by kaolin. Pancreatic amylase can be adsorbed by alumina when in a crude state, but it is no longer adsorbed by special alumina gels when in a state of greater purity.

The specificity of enzymes is well marked in several instances. The observations of R. Kuhn are of particular interest in this connexion. He points out that the sucrase of yeast which hydrolyses sucrose and raffinose is a fructo-sucrase, because it attaches itself to the fructose residues in sucrose and raffinose. The sucrase of *Aspergillus oryzæ*, on the other hand, is a gluco-sucrase because it attaches itself to the glucose residue in sucrose: it does not hydrolyse raffinose. Fructose added to a sucrose solution undergoing hydrolysis by sucrase of yeast slackens the velocity of hydrolysis. Glucose, on the other hand, slackens the velocity of the hydrolysis of sucrose by Aspergillus-sucrase.

Willstätter, whilst admitting that W. Ostwald's dictum that catalysis is the acceleration by a foreign substance of a reaction which is already proceeding slowly in absence of that substance, gave a stimulus to research on enzymes, insists that it should not be maintained too dogmatically, since as a dogma it would tend to hinder any attempt to find an explanation of the phenomena of catalysis without intermediate compounds and of the causation of reactions without an influx of energy. Ostwald's conception is easy to understand in the case of hydrolysis of sucrose, maltose, and the fats, and even in certain oxidative changes, but it is difficult to realise in that of some of the desmolases, for example, that of alcoholic fermentation, even when we picture this as a change of oxido-reduction.

When it is considered that these laborious researches are the outcome of but ten years' work, no one can fail to be struck with admiration at the accomplishment of such a feat. Nor is the work the less remarkable when it is examined in detail. The methods of attack that have been devised are of the most ingenious character and have not only achieved their object and carried our knowledge several stages forward, but they have also added indirectly much to the chemistry of the colloidal state of matter.

Highly meritorious as this work undoubtedly is, it still leaves us in doubt regarding the chemical nature of enzymes. Of the true nature of enzymes as substances we know but little. We can only assume their individuality by a knowledge of the reactions which occur in their presence. Their function is to catalyse reactions, and in this respect analogies may be found in the early work of Faraday, Mitscherlich, Berzelius, and others on the catalysis of reactions in inorganic chemistry.

It would seem that in all catalytic reactions the first stage is the combination of the catalyst with the substrate, possibly through the medium of residual affinities. This view is by no means a recent one. It was supported by Fischer and by the work of H. E. and E. F. Armstrong. So far as enzymes are concerned, some idea of the way in which this combination may occur is furnished by the suggestion of Northrop, that, in the case of proteoclastic enzymes, the velocity of the reaction depends not on the dissociation of the enzyme, as postulated by the hypothesis of Michaelis, but on that of the substrate. Thus pepsin, the optimum activity of which is shown in a strongly acid medium, is capable of reacting only with the protein kations and trypsin with the protein anions. Willstätter suggests the existence of a third group of enzymes capable of attacking only undissociated protein molecules, their optimum hydrogen ion concentration corresponding with the iso-electric point of the substrate.

In regard to reactions catalysed by enzymes the question may be asked: Are the final products the result of direct or of secondary changes? The former is that which has long been assumed, whilst much evidence is being accumulated in favour of the latter. Thus the work of Pringsheim on the hydrolysis of starch by amylase indicates that some of the maltose is produced by the mutation of another disaccharide, and more definite evidence has recently been brought forward by Pictet that this disaccharide is one of the γ class. In my own laboratory, work is in progress which confirms this both in the case of starch and of glycogen. Willstätter had not overlooked this possibility. He says:

"The catalyst may function in degrees of association with the substrate, varying from *fixation* to *approach*. It can naturally without extraneous energy bring about a change of constitution in the substrate molecule, and it is only through this

constitutional change that reaction may be induced. Here it is not essential, nor even a general condition, that the molecule should change to a new compound capable of independent existence, as, for example, to an isomeride such as the so-called γ-glucose (with a changed oxygen bridge) which has been postulated as an intermediate in the action of F. G. Banting and E. H. Best's insulin on glucose. . . . F. Haber (1922) considered the heterogeneous catalysis of gas reactions to be a process in which the first phase . . . is apparently represented by an electro-dynamic distortion of the molecules by the atomic fields at the interface between the solid contact substance and the gas. M. Bodenstein also bases an explanation of the activation of hydrogen by platinum on the deformation of the molecules."

Again, considering the chemical nature of enzymes as substance, are they to be regarded as single substances, or are they not rather a system? There is much to be said in favour of the latter view. Despite repeated attempts—none more numerous than those carried out by the Willstätter school—no one has succeeded in preparing a single pure substance from enzyme preparations, possessing activity which characterises these agents as a class. The most highly purified preparations—judging purity by the increased velocity of the reactions they catalyse—have always been mixtures. Moreover, purification by adsorption always stops at a certain point. The classical researches of Harden showed that zymase, or rather yeast juice, may be resolved by ultra-filtration into an inactive thermo-labile colloidal portion and an inactive thermo-stable portion which passes through the filter. The active enzyme is reproduced when these two portions are reunited. The case of trypsinogen may also be cited. This only becomes active trypsin when brought in contact with the enterokynase of the duodenum, which may owe its activating power to the presence of calcium ions. Willstätter in 1922, summarising his views on the nature of enzymes, states that he considers them to be composed of a specific active group which enables them to be combined with the substrate, the composition of which at the same time determines the colloidal nature of the entire complex.

It would seem that researches on enzymes have now been carried to a conclusion so far as is possible with methods at present at disposal. We must patiently await the devising of new means of attack before the problems can be carried to a further stage. Meanwhile universal gratitude must be expressed to Prof. Willstätter and his co-workers for having taught us so much on one of the most intricate problems in the whole range of biochemistry.

ARTHUR R. LING.

Memorials of Galileo.

Memorials of Galileo Galilei, 1564–1642 : Portraits and Paintings, Medals and Medallions, Busts and Statues, Monuments and Mural Inscriptions. By J. J. Fahie. Pp. xxiv + 172 + 47 plates. (Leamington and London: The Courier Press, 1929.) 30*s*.

FEW figures have so struck the imagination of the world as the aged and infirm Galileo. Repressed by the power of the Inquisition, humbled into submission by the temporal power which crushed those deeper stirrings of the human spirit that were leading men to new conceptions of the universe and of man's place therein, "My name is erased from the book of the living", he wrote to his loved daughter. Yet through well-nigh four centuries the roll of his disciples has not closed.

Not least in devotion has been the author of the finely produced volume now before us. Mr. Fahie's engineering knowledge and long experience in Italy have given him an intimate appreciation of much of Galileo's achievement. Yet more fundamental to his work have been the affection and veneration which Galileo has inspired in him. Mr. Fahie has devoted years to the study of his master, and he became the chief collaborator of the late Prof. Favaro in the preparation of the great national edition of the works of Galileo published by the Italian Government. English readers are already indebted to Mr. Fahie for his volume, "Galileo, his Life and Work", published as far back as 1903, and for his study of "The Scientific Works of Galileo" in 1921. Probably no other man now living is equipped with the knowledge which makes these "Memorials" a volume full of charm and interest as well as an authoritative reference book on its subject.

Every authentic portrait of Galileo finds a place in this volume. The sources of prints as well as of paintings have been traced, and errors and false ascriptions have been hunted down and exposed. Moreover, a lifelong study has been rewarded by more than one important new discovery. The ground is covered with great completeness. The work is divided into six parts: Portraits from life; subject pictures; medals and medallions; busts and statues; monuments and mural inscriptions; and finally, an entertaining appendix on spurious Galileos.

The work is prefaced by a graceful and illuminating character sketch. In few words there is placed before us what we may call the domestic background of the great philosopher, his fondness for gardening, his familiarity with masterpieces of

classical literation, his generosity, his hospitality, and his love of music. Very touching was the devotion of his pupils, especially of the youngest, Vincenzio Viviani, who as a lad of eighteen came to live with the master in 1639, six years after the historic sentence had been promulgated in Rome. A relationship of warm affection was almost immediately established between Galileo and this lad, who became in his turn a leader of the science of the next generation. To Viviani, too, we owe much of our knowledge of the brilliant circle of young men who in the first decade of the seventeenth century formed in Rome the Academy of the Lynx. This was by far the earliest society for the study of natural science, and very early in its career was honoured by the adherence of Galileo.

One of the discoveries of Mr. Fahie is in connexion with a bust of Galileo by Caccini, which was to have been executed as a gift from Salviati for Prince Cesi, the founder and the first president of the Academy of the Lynx. Owing to the death of Caccini, the marble bust was never made, but Mr. Fahie has traced the original plaster model by Caccini himself which now reposes in the Master's Lodge at Trinity College, Cambridge!

Among the things that will strike the reader of Mr. Fahie's beautiful volume is the great number of contemporary portraits. One of the most remarkable and least familiar is that produced from a crayon drawing by Leoni, dated 1624, now preserved in the Louvre. The immense and thought-laden head is here lightened by an expression of benignity in the eyes not always discerned by the artists who set themselves to delineate that countenance. Mr. Fahie reproduces no fewer than four portraits from the hand of Sustermans, but this famous artist did not work on Galileo until after the tragedy of 1633. Three of the paintings were made in 1640. One, and as he believes the original, has been discovered by Mr. Fahie in London in the private possession of Miss V. F. Robinson.

Yet more numerous than the portraits are the later memorials of Galileo. His condemnation by the Inquisition has been the subject of many fine pictures. Many painters have found inspiration in his life in confinement, his thoughts ever occupied by the movements of the heavenly bodies and by the laws of his 'new science' of mechanics. Always he was surrounded by the pupils who venerated him. More than one painter has been stirred to depict the visit of the young John Milton to that venerable figure. Gradually Galileo has become a legend. His name and his achievements have come to hold a special place in the minds of those for whom freedom of thought and speech is a precious human heritage, won with how much suffering and how easily lost!

Medals have been struck and monuments raised in Galileo's honour. In Florence he is commemorated by the Tribuna di Galileo, a department of the Museum of Physics and Natural History. This Tribuna was opened in 1841 and consists of a vestibule, a small hall, and a semicircular inner tribuna. The walls are decorated with frescoes illustrating the achievements of Galileo, while the cases contain instruments with which he won his knowledge. Perhaps no material monument of him is more touching than the bust with inscriptions and representations of his discoveries which Viviani, greatly daring, placed on the front of his own house in the year 1693. Below, a legend for all to see linked the owner of the house with the man whom the Inquisition had condemned: *Monumenti consecrati da Vincenzio Viviani alla memoria del Galileo.*

DOROTHEA WALEY SINGER.

Sex in Savagery.

The Sexual Life of Savages in North-Western Melanesia: an Ethnographic Account of Courtship, Marriage and Family Life among the Natives of the Trobriand Islands, British New Guinea. By Prof. Bronislaw Malinowski. Pp. xxiv + 506 + 96 plates. (London: George Routledge and Sons, Ltd., 1929.) 42*s.* net.

ALREADY the admirable volume under review has created an interest far wider than its primary appeal to professed anthropologists would indicate, and it may confidently be claimed for it an established place as a sociological classic, which in future no serious student of culture in its broadest terms will be able to pass by.

So slight, and for the most part unmethodical and unscientific, have been all previous studies of the sexual life of primitive peoples in the English language, that Prof. Malinowski's becomes the first really important work in this line of research. In previous volumes he had led up to this more detailed and embracing study by discussing special problems in psychology and sociology, for example, the Freudian incursion into cultural anthropology, and, in other volumes, primitive law, economics, myth, religion, and folk-lore. Other workers approaching these subjects from outside have too often muddied the stream of knowledge and theory by speculations and reconstructions not based on observable facts.

In this volume we are given a very full and

detailed picture of the erotic and family life of Trobriand Islanders. It is, of course, apparent that what is typical of Trobriand tribesmen is not necessarily typical of primitive communities, or even of all Melanesians. Here we are studying a mother-right and matrilineal community in which a man inherits from his maternal uncle, in which the real father's part in procreation is shown to be as unknown as the late Sir Baldwin Spencer showed it was unknown amongst the Arunta of Australia, in which, subject to certain exogamic and kinship taboos, prenuptial and even prepuberal sexual intercourse is almost unrestrained. In every instance where he is dealing with the beliefs and practices of the natives, the author's peculiarly intimate knowledge of the language, his own psychological penetration and his familiarity with a mass of comparative material, enabled him, not merely to state custom and belief in native terms, but also to demonstrate how logically they do arrive at those beliefs. For example, the native refusal to believe that sexual intercourse is necessary to procreation is applied to their theories on the breeding of pigs. The male function is merely to 'open up' by hymeneal penetration and prepare the channel of ingress for the spirits, which are the real fertilising agents. In defence of this belief, the natives point to the free sexual life of unmarried girls and the comparative absence of illegitimate children. Since, they argue, all women, married or unmarried, have either husbands or lovers, but only some have children, the father's part cannot be essential.

In this connexion we touch on a problem of some biological importance, the solution of which lies, as Prof. Malinowski avers, outside the scope of his work. It is one, however, which I have had under consideration as the result of observations made amongst other Pacific peoples. Where, as in the Trobriands, prenuptial intrigues are the rule, illegitimate births are none the less discountenanced, and, by all the evidence, in any case, remarkably rare. The common and easy explanation that unmarried mothers practise abortion, or that some unanalysed and mysterious form of contraception is practised, is quite unsupported by any evidence in the communities in question. This latter popular explanation is particularly inappropriate in the Trobriands, where the fertilising function of seminal fluid is unknown. Yet girls habitually begin an active sexual life from the time they are still quite small children, and, until they marry, remain sterile. After they marry they breed and are often prolific. In the Trobriands, if, as rarely happens, an unmarried girl becomes pregnant, her lover, so far from then being more inclined to marry her, would on the contrary at once repudiate her; not, of course, because of any suspicion of a rival's responsibility, but simply because it is a violation of custom and even more discreditable for an unmarried girl to have a child than for a married woman to remain sterile. The only explanation that I am inclined to put forward touches the postulated law that monandrous matings only are favourable to fertility. The mechanism of it may, it is suggested, be discovered to lie in the autotoxitous properties of spermatozoic saturation. The experiments still being carried on in California and elsewhere in spermatoxins and sterilising serums, associated with work begun by Dittner, Guyer, and others, may eventually reveal the true physiological or biochemical explanation. Meanwhile, a study of tertiary sex-ratio variations will illustrate the world-wide tendency for the substitution of monandrous and polygynous groups for polyandrous groups in a population. This substitution occurred quite clearly, for example, in the Toda population in recent years. We may see here its bearings upon the institution of marriage and polygamy. This question is one amongst many showing the need for a closer collaboration between sociological, demographic, and biological researches.

Here and there the author has to touch on the gradual changes brought about by the influence of contact with European civilisation. Often this influence is exercised deliberately and directly by government officials and missionaries determined to reform and 'uplift' the morals of the debased savage. In almost every instance that influence has been harmful and has resulted in the weakening or destruction of the morality that once existed. The segregation of sexes on plantation compounds and mission stations has lead to homo-sexual practices previously practically unknown; violation of the taboo on incest is now brazened out, where exposure would formerly have led to suicide; missionary attacks on native polygamy and the institution of the boys' houses, *bukumatula*, have merely helped to make adulteries more easily accomplished without punishment, have undermined the power of the chiefs, and disintegrated society. A new cynicism and hypocrisy is the chief lesson the white man's religion teaches.

Mr. Havelock Ellis, in his preface, makes an eloquent plea for a full and scientific consideration of the underlying sexual facts in all sociological inquiries, free alike from the traditions of Anglo-Saxon Puritanism and the almost equally

unfortunate reactions to which the revolt against those traditions may lead. After a study of Prof. Malinowski's work, we may indeed be inclined to think Mr. Ellis's statement that "Sex-taboos weigh at least as much on the civilised as on the savage mind" an under-statement.

GEORGE PITT-RIVERS.

Our Bookshelf.

West African Secret Societies: their Organisations, Officials and Teaching. By Capt. F. W. Butt-Thompson. Pp. 320+12 plates. (London: H. F. and G. Witherby, 1929.) 21*s*. net.

THE West African secret societies, according to Capt. F. W. Butt-Thompson, fall into three groups: the mystic and religious, the democratic and patriotic, and the subversive and criminal; some are ancient pagan institutions, others are Mohammedan, there is a group of Mohammedan-pagan societies, and there are more modern ones. The various aspects and activities of the societies, such as organisation, officials, initiation, religious teaching, etc., are given in appropriate chapters with reference to particular societies; thus the reader can appreciate what factors are common to most of them, and so is enabled to gain a bird's-eye view, as it were, of their general functioning. Finally, there is a very brief account of each society.

This is the first systematic book on the subject, and the author is to be commended for the considerable amount of information here summarised. Judging from the bibliography, he has searched diligently through the literature which has any bearing on his subject, and he appears to have got into friendly contact with many Africans in the different countries of which he treats, especially in Sierra Leone, but unfortunately there is no indication concerning what is due to original observation and what is taken from published sources, so there is no means of gauging the reliability of the statements here made.

It is a book that tells in brief many things about which we should like to know more, and though Capt. Butt-Thompson records such information as may be obtained by a white man concerning the old social discipline and morality, there must be much more of which probably only an African can enlighten us. As in many primitive communities, some of the ethical teaching, such as that given on pp. 208-9, is good enough for any people to practise, however advanced their scale of life; for example, "Respect and obey your father and mother". "Be just to your enemy; rescue him when he is in danger, and never go out of your way to get him into trouble." "Stealing is undignified; if you covet a thing, ask for it; if it is refused, go without it." A people that preaches these maxims cannot lightly be dismissed as 'heathen', nor can their secret societies always be branded as 'wicked'. The author makes us wish that we could get into real and close touch with the teachers of these doctrines, and work out with them a better and a fuller way of combining their knowledge and aspirations with our own for the benefit and advance of the African. A. C. H.

The Private Life of Tutankhamen: Love, Religion and Politics at the Court of an Egyptian King. By G. R. Tabouis. Translated by M. R. Dobie. Pp. xxiii+322+16 plates. (London: George Routledge and Sons, Ltd., 1929.) 15*s*. net.

To attempt to recreate the atmosphere and reconstruct the conditions of a whole period of history so remote from our own times as the XVIIIth dynasty of ancient Egypt, requires considerable courage. It is a task to which the genius of the French language is perhaps more readily adaptable than our own. Certainly in one or two places this translation of Mlle. Tabouis' book on Tutankhamen carries less conviction than it would in the original. On the whole, however, it is a sound and informative piece of work such as should appeal strongly to the general public. The period with which she deals is one of the relatively few epochs in Egyptian history possessing an individuality and a character comprehensible by a reader who is not already acquainted with the phases of development of Egyptian culture in some detail.

An account of Akhenaton and his religious and social reforms necessarily occupies a prominent place in the book, which is thus given a certain dramatic unity, so much so that, instead of a life of Tutankhamen, it might well be regarded as the story of the rise and decay of the materialised ideal of a political and religious dreamer. M. Theodore Reinach contributes a preface, which is illuminating in the way it sets out in a few paragraphs the distinctive characteristics of Egyptian political development, which play so large a part in the history of Akhenaton's reforms, and also in giving the historical perspective necessary to appreciate the place of the XVIIIth Dynasty in Egyptian history.

The Life of Space. By Maurice Maeterlinck. Translated by Bernard Miall. Pp. 171. (London: George Allen and Unwin, Ltd., 1928.) 6*s*. net.

SINCE the publication of work on the theory of relativity during the War made this subject one of popular interest, there have been many attempts to interpret the significance of the theory in its relation to everyday life. The problem of the fourth dimension is one which occasionally is transformed from the symbolical language of mathematics to the imaginative fancy of popular writing. It is therefore with added interest that one turns to a book of this description by Maurice Maeterlinck. The work is divided into five sections, but the first one, namely, that of "The Fourth Dimension", is the longest and gives various references to writers who, like Hinton and Ouspensky, have devoted considerable thought to the implications of the fourth dimension. Maeterlinck then deals with "The Cultivation of

Dreams" and makes particular reference to dreams as premonitory phenomena. The following section is headed "The Isolation of Man" and raises the question of whether the mind may acquire the sense of the fourth dimension, thus being liberated from our present human environment. The book concludes with two short articles on "Marvels of Space and Time" and "God". The subject dealt with is, of course, a very wide one and lends itself to much speculation, and among the great number of names to which reference is made we find those of Eddington and Whitehead.

Old Mother Earth. By Prof. Kirtley F. Mather. Pp. xiv + 177 + 59 plates. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1928.) 11*s.* 6*d.* net.

In view of conditions in Tennessee, where scientific evidence and spiritual exposition continue to be confused with unfortunate public results, it is not surprising that popular American books on geology are still seriously exercised with the views held in ancient Palestine thousands of years ago. Prof. Mather has faced the issue very tactfully in this entertaining volume, which is based on a series of radio talks delivered at Boston. The topics dealt with include the origin of the earth; the evolution of life; the Great Ice Age and its causes; earthquakes and mountain building. All are adequately dealt with, and we are glad to see that the tidal theory of Jeans and Jeffreys is not overlooked in the discussion of "How the World was Made". The treatment of glaciation is excellent, particular pains being taken to prove that the equator had the same relation to the mountains of western America as it has to-day. The illustrations are numerous and effective, and are enlivened by reproductions of medieval representations of Jehovah at work taken from the "Nuremberg Chronicle" of 1493. The book is a well-written and trustworthy introduction to geology, and may be cordially recommended to all who are interested in the lore of the earth as students or teachers.

The Pressure Pulses in the Cardiovascular System. By Prof. Carl J. Wiggers. (Monographs on Physiology.) Pp. xi + 200. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1928.) 14*s.* net.

Written in response to the wish of the late Prof. Starling that the writer should analyse "in the briefest possible manner, the present state of our knowledge concerning the pressure pulses in the cardiovascular system", it is impossible to indicate in a paragraph more than the purpose of this book, and to commend the thoroughness and care with which the work has been done. The elucidation of the dynamics of some relatively simple physical system frequently entails much preparation and ingenuity in experiment. The first chapter of this work will indicate to the curious how vast and intricate a preparation has gone to the study of the dynamics of the animal cardiovascular system. There has developed a technique which not more than ten investigators have mastered. "We cannot deny that the circulation of an animal is affected adversely by such experimental influences as artificial respiration, anæsthesia, hæmorrhage, nerve stimulation, exposure of heart and lungs, insertion and fixation of cannulæ. We can nevertheless maintain that it is quite possible to obtain circulatory conditions which appear to be normal to all criteria which we are able to apply." Such an assertion argues a great confidence in an investigator, a confidence which, if justified, marks a great victory for ingenuity over the difficulties of animal experiment.

Contributi del Laboratorio di Statistica. Serie Prima. (*Pubblicazioni della Università Cattolica del Sacro Cuore, Serie ottava: Statistica*, vol. 3.) Pp. vii + 436. (Milano: Società Editrice "Vita e Pensiero", 1928.) 50 lire.

This book contains the researches of statisticians of the laboratory directed by Prof. M. Boldrino, on a varied group of phenomena, for example: the eugenic effect of wine consumption; passenger traffic on Lake Maggiore; the proportion of the sexes at conception and birth; death from a single cause; progressive paralysis in malaria districts. Among such a miscellaneous group of subjects one can find a certain unity due to the method of treatment and to the work being the product of a single laboratory. Some of the conclusions drawn from the statistics employed are very interesting.

(1) That alcoholic intoxication appears to have serious consequences only at a rather advanced age, so that its eugenic effect should be small.

(2) That the human sexes are conceived in equal numbers.

(3) That the relative frequency of progressive paralysis in malaria districts is high and tends to become less in those districts where malaria is less rife. This is curious in view of the successful treatment of progressive paralysis by inoculated malaria.

Sunrays and Health. By Ronald Millar, in collaboration with Dr. E. E. Free. Pp. vii + 125. (New York: Robert M. M'Bride and Co., 1929.) 1.50 dollars.

This small volume gives a popular account of the physics and therapeutic uses of light, with special reference to the ultra-violet rays. The text is in a conversational and simple style, and although certain details refer more especially to the continent of America, it can be recommended for perusal by anyone who wishes to have some knowledge of the uses and abuses of a much-advertised remedy. The author gives simple instructions for sun-bathing and points out the dangers of over-exposure: burning the skin is deleterious and unnecessary as a prelude to a becoming tan. He also points out the advantage of exposure to sunlight or skyshine in the open air with the accompanying effect of the cooling power of the air on the skin resulting in stimulation of metabolism and benefit to health. For those who wish to expose their skin to ultra-violet rays during the winter, directions for time of exposure and distance from the lamp are given. In conclusion, this is a sane and readable account of a natural remedy which many are inclined to take in excessive doses.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Low Atomic Energy Levels for Elements of the Oxygen Group.

FROM spectral theory it is known that the lowest energy states for atoms of the oxygen group form a stable triad designated as $^3P_{012}$. Next higher to these is a metastable state $^1D_2$ and next to that again a metastable state $^1S_0$. For oxygen atoms the state $^3P_1$ expressed in frequency units is known to be 67 cm.$^{-1}$ higher than the state $^3P_2$ and the state $^3P_0$ 158 cm.$^{-1}$ higher than the state $^3P_1$. The states $^1D_2$ and $^1S_0$ have not hitherto been evaluated for oxygen atoms.

In the course of a recent investigation of the spectra of selenium and tellurium, we were able to identify all the energy levels $^3P_{012}$, $^1D_2$ and $^1S_0$ for the neutral atoms of both elements. The results are given in the following table:

	$^3P_2$	$^3P_1$	$^3P_0$	^3P mean	$^1D_2$ (suggested)	$^1S_0$ (suggested)
Oxygen	0	67	225	97	10587	28512
Energy differences				10490	17925	
					λ5577·341 A.	
	$^3P_2$	$^3P_1$	$^3P_0$	^3P mean	$^1D_2$ (suggested)	$^1S_0$ (suggested)
Sulphur	0	398	572	323	9523	25723
Energy differences				9200	16200	
					λ6300 A.	
	$^3P_2$	$^3P_1$	$^3P_0$	^3P mean	$^1D_2$	$^1S_0$
Selenium	0	1991	2535	1509	9576	23370
Energy differences				8067	13794	
					λ7247·5 A.	
	$^3P_2$	$^3P_0$	$^3P_1$	^3P mean	$^1D_2$	$^1S_0$
Tellurium	0	4707	4751	3153	10559	23199
Energy differences				7406	12640	
					λ7909·2 A.	

For tellurium it will be seen the terms $^3P_{012}$ are partially inverted, $^3P_1$ being higher than $^3P_0$. Mean values for the energy levels $^3P_{012}$ are 1509 cm.$^{-1}$ for selenium and 3153 cm.$^{-1}$ for tellurium. If we consider the ratio $(^1D_2 - {}^3P_{\text{mean}})/(^1S_0 - {}^1D_2)$ we obtain the value 0·585 in the case of selenium and 0·586 in the case of tellurium.

From observations made on the Zeeman effect with the oxygen green line λ5577·341 A. and described by Prof. McLennan in his Bakerian Lecture (NATURE, July 7, 1928, p. 38, and *Proc. Roy. Soc.*, No. A 785, vol. 120, p. 327), it became definitely known that the auroral green line λ5577 A. originates in electronic transitions between the metastable states $^1S_0$ and $^1D_2$ of oxygen atoms. It has a frequency, therefore, given by $\nu = {}^1S_0 - {}^1D_2$ which, expressed numerically in frequency units, is equal to 17924·7 cm.$^{-1}$. If we suppose that the ratio $(^1D_2 - {}^3P_{\text{mean}})/(^1S_0 - {}^1D_2) = 0{\cdot}585$ be applicable to the spectrum of oxygen as well as to the spectra of selenium and tellurium, we obtain 10490 cm.$^{-1}$ and 28415 cm.$^{-1}$ for the mean energy difference $^1D_2 - {}^3P_{012}$ and $^1S_0 - {}^3P_{012}$ for oxygen atoms. From this it follows that the radiation corresponding to the electronic transitions $^1D_2 - {}^3P_{012}$ in oxygen should have a mean wave-length of approximately λ9530 A. and that corresponding to the transitions $^1S_0 - {}^3P_{012}$ an approximate wave-length of λ3520 A. This means that we should expect to obtain in the spectrum of the polar aurora and in that of the light of the night sky a close triplet in the neighbourhood of λ9530 A. and a similar one in the neighbourhood of λ3520 A., the separations in both cases being 67 cm.$^{-1}$ and 158 cm.$^{-1}$. Up to the present such radiations have not been observed either in polar or non-polar auroral light or in the spectrum of atomic oxygen. They should, however, be carefully looked for and experiments in that direction are now being set in train by one of us.

From the numbers given in the table above it will be seen that the lines in the spectra of selenium and tellurium analogous to the auroral green line of oxygen have the wave-lengths λ7247·5 A. and λ7909·2 A. respectively. Moreover, by extrapolation from the numbers given in the table, one is led to the view that a line in the spectrum of sulphur analogous to the auroral green line of oxygen should have an approximate frequency of 16200 cm.$^{-1}$ and an approximate wave-length of λ6300 A.

J. C. MCLENNAN.
M. F. CRAWFORD.

The Grant of Invalid Patents.

THE trend of the excellent leading article in NATURE of Nov. 9, on "The Grant of Invalid Patents", is to recommend that more power be entrusted to the Patent Office because of the great evil of expensive patent litigation, but in the course of the article two statements occur which I submit are misleading. The writer says (1) that opposition proceedings before the Comptroller are coming to be used as a cheap method of obtaining an official opinion of validity. Now I believe it to be beyond dispute that the Comptroller's decision has no importance whatever as a certificate of validity, and validity is not a question with which he is at all concerned at the hearing of the opposition proceedings. Definite grounds of opposition are laid down by sec. 11 of the Act, and with them he is alone occupied.

Prior publication and prior grant may be, and are commonly, an issue before him, but his decision on these points merely amounts to saying that he cannot find the applicant's invention expressly stated in other specified documents which are put before him, and his decision on the point has no weight whatever in a subsequent action in the High Court.

Secondly, the writer says that the *quale* of subject matter is already handled by the Patent Office. This is only true in the limiting sense that the Patent Office will not grant a patent for something which is *manifestly* not a manner of manufacture, for example, a system of indexing *or* a medical treatment, even though it was described as a "method of extracting lead from men". Yet with this limitation any experienced patent agent will say that it is nearly always possible to get an invention through the Patent Office.

Space does not permit me to enlarge generally on the other point of view, though on it there is much to be said. There is the danger of allowing Patent Office officials, excellent and efficient as they are, to decide academically and without proper evidence on what are after all practical questions—I say without proper evidence, for a full-dress trial at the Patent Office would, except for the comparatively small court charges, be as expensive as a trial in the High Court. Again, Patent Office 'mistakes' would be serious, for they would mean that improper grants were made, or that grants were improperly refused. So far as the lawyer is concerned, it might well happen that although the excessive cost of patent actions was reduced there would, nevertheless, be a very much greater number of small patent actions!

Is it not true, however, that the real cause of the expenses of the big patent actions is not so much the law as the exceeding complexity of modern science and technical knowledge, coupled with the immense financial interests which to-day exist in business?

CARROL ROMER.

5 Crown Office Row, E.C.4,
Nov. 11.

MUCH of the leading article in NATURE of Nov. 9 involves the assumption that the purpose of patents is to encourage inventions, or even inventors. There may have been a time when that was true, though it must be remembered that the grant of a monopoly was originally a bribe for the disclosure of an invention, not a reward for making it; but it belongs to the remote past. It was a time when the same person could be inventor, workman, foreman, manager, and director, when organised research was unknown, and industry progressed unforeseeably by discontinuous mutations. In the completely different economic and intellectual atmosphere of the modern world, the patent machine has ceased to work according to the intentions of its designers and cannot fulfil the purpose for which they designed it. With our admirable English adaptability, the envy of all foreign observers, we have converted it to other purposes, not less vital to the community. Patents now serve to provide financiers with convenient weapons for their mutual warfare, and patent agents with a living.[1] The British Science Guild wisely recognised the change when it constituted its Patents Committee mainly of those who regard an invention merely as the occasion for the issue of a legal document. Industrial scientists would be wise to recognise it too.

For in these days of trade unionism and rationalisation, no tinkering with patent law can enable an isolated inventor to fight an industry. In particular, what is the good of deciding the issue of validity once for all in the Patent Office, when the closely related issue of infringement cannot possibly be decided until it arises? The Patent Office may declare generally that the patent claims something validly, but that something can only be defined by particular instances. Attempts to deprive wealth of its influence in one direction only drive it to seek influence in another, and the search is never long; as many have asked before, if there were really justice between rich and poor, what would be the use of being rich? Instead of claiming rights of which the evolution of society has deprived us for ever, let us make the most of those that it has newly conferred on us. When the foundations of the patent law were laid, no one could earn a salary by indulging his disinterested curiosity.

NORMAN R. CAMPBELL.

155 Hagden Lane,
Watford, Herts.

IN reply to Mr. Carrol Romer's letter: it certainly is true that the Comptroller cannot give a certificate of validity or tie the hands of a higher court. The leading article was not intended to convey that impression at all. But it is also a fact that the carefully reasoned decisions, commonly running into 5000 or 6000 words, which are nowadays a feature of opposition proceedings, help the parties to see exactly where they stand, and often enable them to come to terms. In the event of an appeal, time (and therefore expense) is saved in the appeal proceedings by the Comptroller's preliminary elucidation of the issues. Does Mr. Romer seriously maintain that the grounds of opposition are irrelevant to validity?

Mr. Romer seems to hold the view that the Comptroller does not enforce amendments, or otherwise exert his powers, except in such extreme cases as that in which an invention has been wholly and specifically described in a prior publication. That view is directly contrary to the writer's experience. There has been a strong tendency, especially in recent years, for the Comptroller's court to deal quite courageously in realities and not merely in words. Public appreciation of this policy seems to be indicated by the rapidly increasing use which is made of the Comptroller's jurisdiction.

As regards the cost of evidence: an economy would obviously be effected if such issues as documentary anticipation could be kept out of the High Court. Even if matters calling for a good deal of evidence were to be brought within the Comptroller's jurisdiction, a favourable precedent would be found in opposition proceedings based on the plea of 'obtaining'.

In his last paragraph Mr. Romer surely is right in attributing the increasing cost of patent litigation to the increasingly scientific and technical character of industry. It follows that the High Court is ceasing to be a suitable place for the trial of many of the issues which affect validity. A judge's time is too valuable to be properly taken up with those cramming-courses in chemistry, physics, and applied mechanics through which the expert witnesses have to coach him; and patent law forms such a small fraction of the whole body of law that a technical training is more appropriate than a purely legal training for men who have to decide questions of technical fact. It is true that if mistakes made in the granting or refusal of a patent were to be rendered irrevocable, grants would be improperly made or refused, and that would be a serious evil. But the existing state of things is an incomparably *more* serious evil. The risk of minor injustices is preferable to the actuality of major abuses.

Dr. Campbell's statement that "the grant of a monopoly was originally a bribe for the disclosure of an invention" appears to require revision in view of the actual history of the matter. The writer is inclined to agree, however, that if the minds of the British Science Guild Committee had not been biased by a practical knowledge of their subject, their report would probably have been characterised by a high degree of novelty, though it might have fallen short in point of subject-matter and utility.

After all, the battle is not always to the strong, even under existing conditions. If the patent system were to be 'tinkered up' with courage and foresight, the duration of High Court proceedings might be considerably shortened, and then the salaries to be gained by indulgence in disinterested curiosity might come to be levelled up to a more satisfactory general average than that at present available.

THE WRITER OF THE ARTICLE.

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[1] The fees paid to a few leading counsel always attract attention, but the fees paid to patent agents are much larger in aggregate; their function, if patents had retained their original purpose, would have been equally parasitic.

The Permeability of Plant Cell Membrane to Sugar.

THIS communication deals with a glucose effect on the permeability of cell membranes to sugar molecules as studied by the intensity of respiration when leaves of *Artocarpus Integrifolia* were injected with varying concentrations of glucose solution. The investigation developed as a very interesting by-product of other investigations on respiration. Though the important

rôle of carbohydrates in the physiology of the living cell has been recognised for a very long time, our knowledge concerning the direct penetration of living cells by carbohydrate molecules is only recent. Scarcely anything is known, however, about the effect of sugar on the permeability changes of cell membranes to diffusion of sugar molecules. Curiously, the direct evidence for an effect of this kind of sugars on the permeability of cell membranes is obtained from an investigation which had primarily nothing to do with the problem.

The investigation was concerned primarily with the study of respiratory intensity when starved and unstarved leaves were injected with varying concentrations of glucose solutions. The curves obtained in that connexion could not all be explained on the basis of a simple relationship between concentration and respiratory intensity, for which an explanation had to be sought.

Observations of the rates of respiration were recorded on the control and the experimental leaves simultaneously. For purposes of analysis, from the curves thus obtained the per cent algebraical increase of respiration of the experimental leaves over the controls have been calculated and exploited.

The equations for the curves of the hourly march of these values work out in a very simple way in the majority of these curves. They can be expressed as simple logarithmic curves.

For comparing the relationship between the concentration of sugar solutions and the respiratory intensity, the *initial* values obtained by extrapolating these curves to zero time have been plotted against the corresponding concentrations.

The generalised curves thus obtained at different temperatures show an ascending and a descending phase. It is the ascending phase which forms the special feature of this communication. This phase shows the mathematical relationship $R = K.Ct^n$, where R is the rate of respiration, Ct the concentration, K a constant, and n an index which is greater than unity, that is, respiration increases relatively more as concentration increases. This is explained in terms of the relatively greater rate of diffusion of sugar molecules as concentration increases. The only way in which this can happen is through variations in the permeability of cell membranes to the diffusion of sugar molecules as the concentration of glucose solution increases, thus supplying direct evidence of the effect of glucose on the permeability of cell membranes.

In the equation given above, K represents the diffusibility factor for the diffusion of sugar, which would vary at different temperatures, and the index n the factor for variations in the permeability of cell membranes as the concentration of the solution increases.

In view of these results, the effect of various carbohydrates on the permeability of cell membranes must be known before one can investigate their quantitative effects on various physiological processes of metabolism, such as respiration, etc.

R. S. INAMDAR.
K. V. VARADPANDE.
Benares Hindu University, India,
Oct. 20.

A Lantern Slide Model of the Wave Electron.

LECTURERS on the more popular aspects of the wave-electron may be interested in a simple lantern slide model for demonstrating the waves which I have not seen previously described. Based directly on an explanation given by de Broglie in his "Recherches sur la Théorie des Quanta" (*Ann. de Physique*, **3**, p. 22; 1925), it has the advantage not only of showing the waves to an audience, but also of giving perhaps some insight into their nature. The model consists merely of the diagram of lines shown in Fig. 1, which can be pushed horizontally in the lantern behind a fixed vertical slit.

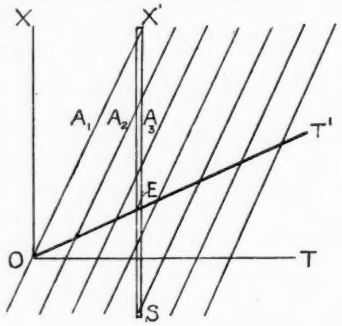

FIG. 1.

The figure represents the space-time diagram of the observer of a moving electron. The observer is represented by the successive points of his time line OT, while of his space axes only OX is drawn. The time line of the electron, in motion with respect to the observer parallel to OX, is OT^1. Now the electron has a known energy, $w = mc^2$, which on the electromagnetic theory is spread out in space round it, and also associated with the electron in some way (perhaps it is rotating with a fixed angular momentum), an elementary quantum of action, h, has to be admitted. From these known quantities we can deduce a certain time,

$$\tau = \frac{h}{w}.$$

(8×10^{-21} sec. for slow motion), and the diagram can be divided into cells, each containing the action h, by lines separated by intervals τ (measured along OT). These lines, representing instantaneous spaces associated with the electron, must be drawn perpendicular to OT^1. It is, however, a well-known feature of the pseudo-Euclidean geometry of space-time that a line which satisfies the analytical conditions of perpendicularity to OT^1 lies actually parallel to OX^1, where $\angle XOX^1 = \angle TOT^1$ when the velocity of light is taken as unity. The lines, A_1, A_2 . . ., separating the successive action cells, appear consequently as shown.

Now when the slide is covered by an opaque screen with a slit S in it, and the diagram is moved behind it from right to left, we see the electron E moving up the slit with the velocity v, while a train of phase waves, formed by those parts of the lines between the cells of action which show through the slit, passes up through the electron with a velocity c^2/v in a very realistic way. Transparent lines on a dark background give the best effect.

S. R. MILNER.
The University,
Sheffield.

The Subdivisions of the Order Primates.

IN his Croonian Lecture on "The Developmental History of the Primates", Prof. J. P. Hill referred to the late Dr. Hans Gadow's subdivision of the Primates into three sub-orders for reasons which I have previously explained in some detail (NATURE, May 2, 1907, vol. 76, p. 7, and *Proc. Zool. Soc. Lond.*, 1919, published Feb. 1920, p. 465).

My colleague has suggested that I should put on record the circumstances in which Dr. Gadow created the sub-order called by him 'Tarsii'.

In 1898, when Dr. Gadow was preparing for the use of his students the book "A Classification of Vertebrata", the International Zoological Congress was held at Cambridge. He undertook the task of translating and elaborating Haeckel's address to the Congress, which was afterwards published as a book under the title "The Last Link".

In the course of this task Dr. Gadow was faced with the difficulty of bringing into harmony the views expressed at the Congress respectively by Haeckel and Hubrecht. The former regarded the lemurs as ancestors of man and as Primates belonging to the same sub-order as *Tarsius*, whereas the latter wanted to exclude the lemurs altogether from the Primates and to regard the tarsier almost as an Anthropoid. Gadow invited me to Shelford to wrestle with this difficulty, and, after several days' discussion, he decided that there was only one way of effecting a reasonable compromise between the conflicting views. While the lemurs could not be eliminated from the order, they should be separated from the tarsiers. Hence he proposed a subdivision into three sub-orders, which he called respectively Lemures, Tarsii, and Simiae. Several years later (op. cit. *supra*) I brought these terms into closer relationship with traditional usage by calling the sub-orders Lemuroidea, Tarsioidea, and Anthropoidea. My colleague, Prof. J. P. Hill, has still further clarified the position by separating monkeys (which might be called Pithecoidea) from the apes and man (to which the term Anthropoidea might be restricted) as separate sub-orders—a proposal made by Friedenthal more than twenty years ago, the justification for which was graphically expressed in the phylogenetic diagram in my "Evolution of Man".

By emphasising the nearness of man's affinity to the anthropoid apes, this proposal gives expression to a conclusion which recent research in comparative anatomy, embryology, hæmatology, and immunology is making necessary. G. ELLIOT SMITH.

University College,
London, W.C.1,
Nov. 25.

Lankester's 'Gregarine' from the Eggs of *Thalassema neptuni*.

OUR attention has been directed by Mr. A. D. Hobson, of the University of Edinburgh, to a sporozoan that attacks the developing eggs in the genital pouches (nephridial sacs) of the echiuroid worm *Thalassema neptuni* Gärtner. Of twelve females examined at Plymouth this autumn, eight showed a heavy infection. It is clear that the parasite is the 'Gregarine' observed by Ray Lankester in the eggs of one mature female among those he collected on the south coast of Devon and briefly mentioned in a paper published in 1881 (*Zool. Anz.*, Jahrg. 4, p. 250). Prof. and Mrs. Goodrich in their paper on *Gonospora minchinii* (*Quart. Jour. Microsc. Sc.*, vol. 65, p. 157; 1921) refer to Lankester's notes, but no one seems to have investigated further the organism from *Thalassema*.

A preliminary examination has shown us clearly that it is not a gregarine, but a coccidian; and as this is, so far as we know, the first recorded instance of such a parasite within an egg, we propose to work out the life-history in detail.

It is not surprising that Lankester supposed he was dealing with a gregarine, for the trophozoite is a long, worm-like body, 200 μ to 400 μ in length and 16 μ to 22 μ broad. The cytoplasm is densely granular and appears white by reflected light; the pellicle is very thin; the nucleus lies in the centre of the body. At this stage the parasite is coiled up within the egg; sometimes three occur together. When pressed out from its shelter, it shows no movement. The parasitised eggs degenerate and are liable to phagocytic invasion. We believe that we have found the schizogonic phase, in which 40 to 50 merozoites are formed, each measuring about 16 $\mu \times 12$ μ. The gametocytes are spherical, the female larger than the male; occasionally a male and a female lie within the same egg. The males give rise to a very large number of flagellated microgametes. We have not yet found the oocysts or spores, and so cannot at present say anything more precise as to the systematic position of the coccidian.

The only true gregarine we have seen in *Thalassema* is a cephaline form living in the gut, sometimes in company with the ciliate *Ptyssostoma thalassemæ* Hentschel. D. L. MACKINNON.
H. N. ROY.

King's College, Strand,
London, W.C.2,
Nov. 21.

Influence of the Para-Foveal Regions on the Foveal Region of the Retina.

THE following simple experiment shows the above influence in a very conclusive manner. Let a piece of black cardboard eight inches square be taken and place this on a wall paper with a coloured pattern. The light in the room should not be too bright, but the experiment can be done easily in an ordinary room with the daylight of the present time. The black cardboard should be viewed with one eye at a distance of six feet, the eye being kept as immovable as possible. It will then be noticed that portions of the colours of the wall paper will appear to detach themselves from the wall paper and move with a slow spiral motion into the black area. This will go on until the whole black area has completely disappeared, the surface being covered with a mixture of colours similar to those on the wall paper.

If a Persian carpet be used for the purpose of the experiment the area will be covered with a mixture of the colours of the carpet. If a uniform colour be used the black area will be covered by that colour. It may even make another colour disappear. For example, if a piece of red paper an inch and a half square be placed on a piece of yellow-green cardboard the yellow-green will invade the red until only a yellow-green surface is seen. If any difficulty be experienced the reader should try the experiment in a dimmer light, but I have not found anyone, at present, who has not seen the phenomenon with ease. It will be noticed how strongly this phenomenon supports my theory of vision, which I regard as a fact, and it seems impossible to explain it on any other theory. F. W. EDRIDGE-GREEN.

Board of Trade,
S.W., Nov. 19.

Graptolite Centenary.

MY friend Dr. Ami is wrong in supposing that at the University of Birmingham I was associated with the work of Prof. Charles Lapworth on graptolites (NATURE, Nov. 16, p. 766). All that I can claim is to have set him free from some of the routine work of his professorship and thus helped him to find time to undertake more original investigation and writing than he otherwise could have done, including the editorship of the Monograph on the Graptolites, written by Miss Elles and Miss Wood (now Dame Shakespear). W. W. WATTS.

Langley Park Road,
Sutton, Surrey, Nov. 18.

Recent Reactions between Theory and Experiment.[1]

THE RAMAN EFFECT: THE CONSTITUTION OF HYDROGEN GAS.

By Sir ERNEST RUTHERFORD, O.M., Pres. R.S.

IN watching the advance of science, and particularly of the physical sciences to-day, one cannot fail to be struck by the very close connexion between theory and experiment—a relation which is probably more intimate than at any other period of scientific history. Every new experimental observation is at once seized upon to test whether it can be explained by existing theories, and if not, to find the modifications necessary to include it in the general theoretical scheme of natural processes. The mathematical analysis often suggests the possibility of unexpected relations which can be made the subject of fruitful experimentation. These two, in a sense, complementary branches of physics profoundly react and interact with each other, and their united efforts lead to a greatly accelerated rate of advance in knowledge and understanding of the essential principles involved. The rapidity of advance in physics, which has been so marked a feature in the last decade, is mainly due to this close combination of theory with experiment.

It will be seen that this interaction is clearly manifest in the subjects which I have selected to speak of to-day. I wish to refer briefly to certain recent discoveries which have excited much interest among physicists and chemists, and have thrown much new light on problems which have long been the subject of close investigation.

The scattering of light by small particles and the 'Tyndall blue' of the scattered light, when white light from the carbon arc or the sun falls on a solution filled with a multitude of small particles, are well known. The late Lord Rayleigh in 1871 first gave the mathematical theory of the scattering of light by such particles, and was able to account in a general way not only for the colour of the reflected light but also for its state of polarisation. He suggested that light should be scattered, not only by particles containing many millions of molecules, but also by the individual molecules themselves, and that the blue of the sky was probably due mainly to the scattering of sunlight by the molecules of the atmosphere in its path.

This suggestion of molecular scattering was strikingly confirmed by the experiments of his son, the present Lord Rayleigh, who showed that scattering of light could be observed in gases freed from all dust nuclei, and that the light scattered perpendicularly to the direction of the incident beam was mainly plane polarised.

In recent years there have been a large number of investigations on the scattering of light, not only by gases but also by liquids and solids, with especial attention to the amount of scattered light and the degree of its polarisation. I shall not refer here to these results and the interesting deductions that have been made from them, but concentrate attention on a more recent development. Sir Chandrasakara Raman, of the University of Calcutta, who had for many years experimented on this subject, made an important observation which has thrown much new light on this question. For simplicity, suppose that monochromatic light of a definite frequency passes through an organic liquid, say, benzene or toluene, which has been carefully purified. It was observed that the colour of the scattered light was distinctly different from the incident beam, showing that the light had in some way been altered by scattering by the molecules in the liquid. To examine this change more accurately, the scattered light was passed through a spectroscope. A striking result was observed. The strongest line was equal in frequency to the incident light, as was to be expected on the classical theory, but in addition a number of new lines were observed on the low-frequency side of the main line, and a few fainter ones on the high-frequency side. By the process of scattering, a set of new discrete frequencies had thus made their appearance. An excellent account of these beautiful experiments was given this year by Raman and Krishnan in our *Proceedings*. Similar effects were observed by Landsberg and Mandelstamm by examining the light scattered by certain crystals.

Such experiments are not easy, for the scattered light is very feeble, and long exposures with intense sources of light are necessary to bring out the relatively faint new lines. An examination of the results showed that the changes of frequency depend on characteristic frequencies of the molecule, connected with its vibrational states.

The interpretation of these results is most clearly seen by consideration of the similar effects in gases, and we shall consider these first. For example, if ν be the frequency of the incident light, the frequencies of the new lines are $\nu - \nu_1$, or $\nu + \nu_1$, where ν_1 is always found to be a difference between two fundamental frequencies of the molecule. This is completely in accord with the quantum theory of scattering, which was given formally by Kramers and Heisenberg in 1925. It is to be presumed that the light scattered by liquids is of the same nature, and the frequency shifts are due equally to differences of molecular frequencies; although in molecules, which absorb strongly in the infra-red, these differences may themselves appear as actual molecular frequencies.

It is of interest to note that the possibility of a process of this kind, involving the appearance of new frequencies, had been predicted by Smekal as well as by Kramers and Heisenberg. While theory and experiment agree admirably for gases, the theory could not have been legitimately extended to the case of molecules of a liquid, and here the Raman effect provides a new and effective tool for determining frequencies which are naturally present in a liquid or a solid.

[1] From the presidential address delivered at the anniversary meeting of the Royal Society on Nov. 30.

It is clear that this new effect may be of great importance in determining the slow characteristic frequencies of molecules in the infra-red, which may be difficult to measure by other methods. This new discovery, of great interest in itself, thus promises to open up a new field of experimental inquiry and to throw valuable light on the modes of vibration and constitution of the chemical molecule.

It is naturally of great interest to consider the processes occurring in the molecule that give rise to these scattered radiations. The action of a train of waves in its passage through the complex electrical system of a molecule, which may be set in vibration in a variety of ways, is naturally very complicated and difficult to explain briefly in simple language. If, however, we content ourselves with a consideration of the energy changes only in the radiation, and disregard the detailed mechanism involved in the radiation processes, a simple explanation can be offered on the ideas of the light quantum.

We start by observing that it is a general consequence of wave mechanics that if a system possesses a number of states of equal energy, there is usually a finite probability of a transition from one of the number to any of the others. Consider a quantum of light, of frequency ν and energy $h\nu$, falling on a molecule in a given direction. The quantum and the molecule are to be regarded as a single system. This system has a number of other states of the same energy. First, those in which the molecule is unchanged and the original quantum is scattered in a new direction without change of frequency; transitions to these states correspond to Rayleigh scattering. Secondly, other states in which the state of the molecule is changed, its energy being altered by $\pm h\nu_1$, while a quantum of light of energy $h\nu \mp h\nu_1$ is scattered in some new direction. Changes to these states correspond to the Raman effect, where frequencies $\nu - \nu_1$ and $\nu + \nu_1$ are observed. The actual changes occurring in the molecule to give rise to these new frequencies can only be inferred from a detailed consideration of the possible modes of vibration of the molecule itself.

I shall now consider a very interesting discovery which has been made in the past year. It has been found that, in a sense, hydrogen consists of two different kinds of molecules, which under ordinary conditions of temperature and pressure behave in a distinctive way; for example, the specific heat and conductivity of the two kinds of hydrogen are very different. The hydrogen molecule in the normal state consists of two nuclei and two electrons. On the ordinary views of the gas-kinetic theory, it is to be expected that the molecules, in addition to their ordinary velocity of agitation, may rotate on an axis perpendicular to the line joining the nuclei. On the quantum theory, it has a series of states of rotation which are specified in terms of a quantum number which has the values 0, 1, 2, 3, etc. Experiments on the band spectrum indicate that in ordinary hydrogen gas at atmospheric temperature the molecules which have rotation numbers 1, 3, 5, are about three times as numerous as those with even rotation numbers, 0, 2, 4, . . . For convenience, the molecules of even rotation number will be termed α-hydrogen, and those with odd rotation numbers β-hydrogen.[2] When in equilibrium, the relative number of hydrogen molecules in the different rotation states at any temperature is governed by the well-known Boltzmann law of distribution and can be calculated approximately. If, however, ordinary hydrogen gas is reduced to a low temperature, say, that of liquid hydrogen, on the ordinary kinetic theory it is to be expected that the rotation of the molecules should practically vanish; that is, the majority of the molecules should have a rotation number 0 and only a small fraction, depending on the temperature, remain in the higher rotational states.

Actually, however, it is found that while α-hydrogen is mainly in the rotation state 0, the β-hydrogen does not change into the state 0, at any rate for a long time, but retains its individuality, although, of course, the ratio of the number of molecules in each odd rotation state is governed by the Boltzmann law. The surprising fact emerges that the β-hydrogen under the influence of ordinary gas-kinetic collisions is only with great difficulty changed into α-hydrogen. The time required for true equilibrium, after lowering the temperature, may be measured in months, or even in years under some conditions. This interval depends, as we should expect, on the pressure and temperature of the gas, since these govern the number and magnitude of the molecular collisions. This means that a molecule with odd rotation number finds a very great difficulty in passing to the even state of rotation.

A general explanation of this can be given on wave mechanics and appears to be intimely connected with the very weak coupling between a rotation state of the molecule with the spin of the minute individual nuclei (protons) which make up the molecule.

While under normal conditions, the passage of β-hydrogen into α-hydrogen and vice versa is excessively slow compared with the duration of an ordinary experiment, yet the transitions can be greatly accelerated by appropriate treatment of the gas. For example, if hydrogen cooled to a low temperature is subjected to an electric discharge, there is a rapid transformation. The passage of the cooled gas through charcoal immersed in liquid air or liquid hydrogen acts in a similar way. When the hydrogen is rapidly cooled to the temperature of liquid air, the odd rotation states are much in excess over the equilibrium value. The passage through the charcoal causes a rapid transformation of the β-hydrogen and the emerging gas at the temperature of liquid air consists mainly of α-hydrogen.

It is of great interest to note that if the gas is warmed to ordinary temperature after passage

[2] The terms 'para'- and 'ortho'-hydrogen have been sometimes used for what I have called α and β. This seems undesirable, since these names are still required to distinguish the *electronic* states in analogy with those of the helium spectrum.

through the charcoal, it remains mainly α-hydrogen, while hydrogen gas in equilibrium consists only of about one-quarter of α-hydrogen. It has been found that the specific heat of the gas and its heat conductivity at the temperature of liquid air before passage through charcoal are markedly different from the values for the gas at the same temperature issuing from the charcoal. In a sense, we may say that α-hydrogen has been obtained by this process in an approximately pure state. The effect in charcoal cooled to the temperature of liquid helium would be even more complete. It seems probable that the rapid transformation brought about by passage through charcoal is catalytic in nature and may quite likely be due to the dissociation of the molecules into atoms and their subsequent recombination to form new molecules.

This striking and unexpected behaviour of hydrogen—the simplest molecule known to us—is of great theoretical as well as experimental interest. It had been known for some time that no satisfactory theoretical explanation could be given of the change of specific heat of hydrogen with temperature, either on the kinetic theory or with the modifications of the theory based on the older form of the quantum theory.

A new orientation of our ideas was given by the development of the wave mechanics theory. One of the first triumphs of this theory was the explanation by Heisenberg of the complex spectrum of helium. The two types of spectra which appeared were shown to be connected with the different directions of spin of the electrons themselves. In one case, the orbital wave functions were symmetrical and in the other case antisymmetrical. From analogy with the behaviour of the helium atom, Hund showed that it was to be expected that the hydrogen molecules should consist of two kinds; in one, which we have called α-hydrogen, the wave functions were symmetrical in the rotational wave function and in the other, called β-hydrogen, antisymmetrical. It was recognised that, on the wave theory, there must be a very weak coupling between the symmetrical and antisymmetrical states, so that the transition from one state to the other must be fairly slow.

Dennison, in a paper published in our *Proceedings* in 1927, calculated the specific heat of hydrogen at different temperatures on the bold assumption that the time of transition from one state to the other was very slow—of the order of one year—compared with the time required for a determination of the specific heat experimentally. Under these conditions, ordinary hydrogen could be considered to be a mixture of two gases, which have not only different specific heats but a different variation with temperature.

By assuming that the ratio of α- to β-hydrogen was 1 to 3, he found that the calculated and observed specific heats agreed over the whole range of temperature. This ratio between the two states of hydrogen was in accord with the observations of T. Hori on the band spectrum of hydrogen.

Experimental proof of the accuracy of this deduction was soon forthcoming by a variety of experimental methods. Prof. J. C. McLennan examined the Raman effect in liquid hydrogen and found that the changes of frequency observed in the spectrum of the scattered light indicated that hydrogen at this temperature consisted of a mixture of molecules having even and odd rotational states. The relative intensity of the lines was in accord with the relative distribution assumed by Denison.

About the same time experiments were undertaken by Eucken and Hiller and by Bonhöffer and Harteck in Berlin. Eucken and Hiller determined the specific heat of hydrogen under different conditions. Hydrogen at high pressure was kept for some days at the temperature of liquid air, the specific heat was measured at intervals and at different temperatures, and was found to show marked variations with time. The fraction of α-hydrogen was found to vary from 25 per cent at the beginning to 95 per cent after a long interval. It was found that the rate of transition from β- to α-hydrogen at liquid air temperature depended on the pressure of the gas and was approximately proportional to the number of molecular collisions.

Bonhöffer and Harteck used a simpler and more rapid method for following the change of state of the hydrogen under different conditions. By measuring the change of resistance of a heated wire in the presence of the gas, the changes in the heat conductivity of the gas, which varies with the specific heat, were easily followed. We have already referred to their experiments of passing hydrogen through charcoal at low temperature and of the effect of the electric discharge. The results of the beautiful experiments of Bonhöffer and Eucken afford a complete and striking proof that hydrogen under ordinary conditions is composed of two sets of molecules which are transformed into each other so slowly that they may be regarded in a sense as two distinct gases differing in specific heat and conductivity. The specific heat of α-hydrogen at low temperature is greater than that of β-hydrogen. A large quantity of heat is given out in the passage of β- into α-hydrogen. At very low temperatures, the heat evolved in this transformation is greater than the heat of volatilisation of liquid hydrogen.

It may be of interest to note that the peculiar behaviour of hydrogen might have been discovered long ago, for no new experimental knowledge or technique is involved. Attention, however, was only directed to this subject by the failure of existing theories to account for the variation of specific heat of hydrogen with temperature. The development of wave mechanics threw new light on this problem and a happy suggestion, based on this theory, was found to fit in well with the observations on the specific heat. Following this clue, the question was attacked experimentally by several different methods, with results in complete accord with the predictions of theory.

Cinchona in the British Empire.

THE value of the cinchona tree (*Cinchona Ledgeriana*) as a source of quinine is common knowledge, but the considerable work undertaken by British medical officers in the past in making use of the product of this tree as a preventive against malaria is not so well known. The cinchona tree was introduced into both India and Java between the years 1854 and 1864. Prior to about 1880, the world's supply of cinchona bark was obtained from the native forests in Ecuador, Bolivia, and Peru. It was only after the export of bark from these regions could no longer be relied upon that attempts were made to grow cinchona elsewhere. The British were amongst the first to succeed in bringing the tree under cultivation. The pioneers were such men as Weddell, Hasskarl, Markham, Ledger, and others, and it was by their efforts that the establishment of important supplies of the drug became a practical proposition.

The early attempts to cultivate the cinchona tree met with considerable success, and private persons took up the business as a commercial proposition. In the early days of cultivation, experiments were made in India, Burma, Ceylon, Malaya, the Sudan, Jamaica, Trinidad, St. Helena, Mauritius, Australia, and New Zealand; but these experiments were not always followed up to a definite conclusion. In Ceylon and India the efforts were successful, but private planting was soon given up and the Government has been mainly responsible for the supplies. Within the Empire, therefore, at the present day, India is the only country where cinchona is grown on a large scale. There are Government plantations in the Nilghiris in the south, in the Darjiling district in Bengal (perhaps the best known), and a more recently developed one in Burma. There are also quinine factories both in the Bengal and Madras Provinces.

A recent paper by Dr. J. M. Cowan, of the Indian Forest Service and officiating Director, Botanical Survey of India, and Superintendent of Cinchona Cultivation in Bengal, entitled "Cinchona in the Empire: Progress and Prospects of its Cultivation" (*Empire For. Jour.*, vol. 8, No. 1 (1929)), discusses the present position of the cinchona and the future prospects of its cultivation.

The enormous importance to the human race within the Empire of the perpetuation of supplies of quinine will become evident when the question of malaria prevention is considered. We have within the Empire a large proportion of the malarial tracts of the world. Prof. Müller of Cologne estimates that some 800,000,000 people suffer from malaria; and according to Sir Ronald Ross there are 2,000,000 fatal cases every year. It is further estimated by Dr. Andrew Balfour that the direct loss sustained by the British Empire due to sickness and death caused by malaria is in the neighbourhood of between £52,000,000 and £62,000,000 per annum.

Apart from financial considerations, it will be apparent that the responsibilities of the British Empire in this question of malaria prevention or reduction are heavy. The question has become an international one, and an organisation for anti-malarial work has been set up by the League of Nations. The policy of this organisation is primarily the quinisation of affected populations. Hence the cultivation of the cinchona tree becomes a question of first importance. It is to a consideration of this matter that Dr. Cowan's paper is devoted.

In India, then, the cultivation of cinchona is confined to Government activities. It was not until 1910–11 that a similar problem had to be faced in Java. Conferences were held, and manufacturers in Holland and growers in Java came to an agreement by which profits were to be shared and by which prices could be maintained at a level which would show satisfactory returns. The disaster which threatened the Java plantations was averted to a great extent by the adoption of this policy; and supplies are now available for the world demands. That the action taken in Java was thoroughly practical, a comparison between the two countries readily demonstrates. They commenced to give attention to the question about the same time and the facilities in both regions were abundant. Yet Java now produces well over 90 per cent of the world's supply of cinchona bark and India only 4 per cent. A very small percentage of the bark utilised comes from South American forests. The production in India represents only about one-third of the amount actually consumed in the country itself. She is therefore at present not only unable to supply her own demands but also, in common with the rest of the world, is dependent upon the Dutch plantations in Java.

Dr. Cowan explains one of the problems which has so far guided the cultivation of cinchona. "It is a well-known fact that to grow cinchona on the same land for a considerable number of years is a difficult and hazardous undertaking, for the first crop, in some manner not altogether understood, renders the soil, at least temporarily, incapable of producing a satisfactory second crop. As long as there is an unrestricted area of forest land the above factor seems of little consequence, but it makes itself felt more and more as the years go on and there is an increasing shortage of land carrying virgin forest."

Dr. Cowan discusses the methods of growing the crop, for details of which the inquirer is referred to his paper. Harvesting the bark commences in a block from about the fourth year, the material consisting of prunings and thinnings. The crop is reaped, the trees being uprooted so as to obtain the maximum of bark, in about the tenth year. The bark is removed, dried, stored, and then passed on to the quinine factory.

Two problems, in the author's opinion, demand urgent solution: the first is to find additional suitable land, an investigation in which other parts of the Empire should join; and the second is to enhance the output per unit of area. Research work is also

necessary with regard to particular strains which yield high percentages of quinine.

The price of quinine at present is very high—£1 9*s*. 6*d*. per lb.—so high as practically to prohibit extensive anti-malarial measures. On this subject the Royal Commission on Agriculture in India in its report (1928) stated: "If India is to embark on any large campaign for fighting malaria, we are convinced that it will be first necessary to reduce considerably the price of quinine within India, and this can only be effected if India is self-supporting in production. To achieve this self-sufficiency a considerable extension to the present area under cinchona will be required. . . . We are satisfied that, in view of the great importance of extending cinchona cultivation and cheapening quinine, much more scientific investigation is called for than has been undertaken in the past."

Dr. Cowan has done well in summarising the present position and in pointing out the great importance to a large section of the human race of the development of quinine production.

Obituary.

Sir Archdall Reid, K.B.E.

SIR ARCHDALL REID, whose writings on heredity aroused considerable interest among the medical and general public between 1900 and the outbreak of the War, died suddenly on Nov. 18, at Southsea, at sixty-nine years of age.

Sir Archdall Reid was born at Roorki, N.W. Provinces, India, on April 7, 1860, and was the only son of Capt. C. A. Reid of the 20th Bengal Native Infantry, and therefore originally in the service of the Hon. East India Co. He was in his earlier years educated privately, and then studied medicine in the University of Edinburgh, where he took the degree of M.B. For some years after that he led a roving and adventurous life in India, New Zealand, the Pacific, and America, before settling down to general practice at Southsea. He there devoted most of the hard-earned leisure which his professional work left him to the study of heredity, and published several volumes of considerable length on the subject, as well as articles and communications to NATURE. The books are: "The Present Evolution of Man", 1896; "Alcoholism, a Study in Heredity", 1901; "Principles of Heredity", 1905; and "Laws of Heredity", 1910. These writings show that their author possessed an active, independent, and original mind and much ingenuity, but unfortunately the want of a first-hand practical and experimental knowledge in biology prevented him from fully appreciating the technical points of his subject. His point of view was that of the medical man, and he based his arguments chiefly on his knowledge of human disease and immunity.

Sir Archdall's general views of heredity and evolution were adopted from Weismann. He assumed that the differences between organisms were in general adaptive, and that evolution was due to natural selection acting on spontaneous variations, the effects of external stimuli never being inherited. He relied too much on verbal subtleties, which when carefully examined only put what was described before in other words; for example, his distinction between characters developed under the stimulus of nutrition, and those developed under the stimuli of use and injury, which comes ultimately to the same thing as inherited characters and acquired characters. He waged hopeless warfare against the facts and conclusions of Mendelism, which were then arousing enthusiasm among many biologists. One of his attempts to explain away the importance of the Mendelian results was obviously unreasonable. Mendelism was just beginning to consider whether the differentiation of sex was not a Mendelian segregation, when Sir Archdall maintained that "Mendelian inheritance is a human creation, and the right interpretation appears to be that nature treats mutations, when man interferes and presents them to her, as sexual characters". The excuse for this is of course that the genetics of sex and the relation of sex-limited characters to hormones were not then understood as they are now.

Many biologists, however, who reject the possibility of the effects of external conditions being inherited, would probably accept Sir Archdall's facts and conclusions concerning alcoholism and disease as perfectly sound. His view was that "susceptibility to the charm of alcohol" was an innate character and tends as such to be inherited in the same sense as the shape of a person's head; that, as in all innate characters, variation occurs in the tendency to intemperance in drinking alcohol, so that all degrees of it may be said to occur in any population. As in other cases, these variations are subject to natural selection, which means in this case that the worst drunkards are killed off or leave fewer children. The consequence is that peoples which have been exposed to the temptations of alcohol for the longest time are the most naturally temperate, while peoples who have had little or no experience of alcohol, when it is first introduced among them, drink without restraint. This, according to Sir Archdall Reid, is the explanation of the facts that in southern Europe, where the vine has been cultivated from early times, the people are temperate, and that northern peoples, such as Russians, Germans, and English, are more given to drunkenness. Similar arguments and conclusions were maintained by Sir Archdall with much ability and command of language with regard to resistance to disease. "Every race", he wrote, "is resistant to lethal disease in proportion to its past experience of it, but the resisting power is such that it can only have been evolved through Natural Selection."

Throughout the War, Sir Archdall served as medical officer and was made a K.B.E. in 1919.

J. T. CUNNINGHAM.

News and Views.

IT is with widespread regret that the news has been received of the destruction of the non-magnetic research vessel *Carnegie*, and the lamentable death of Capt. J. P. Ault, captain of the vessel, physicist, mathematician, and leader of the expedition, whose magnetic surveys extending over all the oceans since 1909 are known throughout the maritime world. The vessel, a brigantine belonging to the Carnegie Institution of Washington, was refitted last year and equipped for oceanographic and meteorological work as well as for the magnetic survey, and was fitted with an auxiliary bronze petrol motor. She had since completed half of the projected cruise of 110,000 miles when, on Nov. 30, refilling petrol in Apia Harbour, Samoa, an explosion occurred resulting in her total destruction. No other member of the scientific staff of eight received serious injury, from the reports yet seen. The Carnegie Institution has furnished classic material relating to the magnetic variation, dip and ocean meteorology, from the previous expeditions of this vessel and her predecessor under the leadership of Capt. Ault. During this cruise, data have also been obtained of the electric condition of the atmosphere at different levels, of wind velocities by means of pilot balloons, of atmospheric refraction, the intensity of solar radiation, temperature and humidity lapse rates above the sea. In addition, much oceanographic data have been collected, numerous stations having been worked from top to bottom for temperature and salinity of the water, which will add to our present knowledge of the hydrodynamics of ocean currents in the North Atlantic and Pacific. The nutrient salts, phosphates, and nitrates, necessary for and usually limiting plant life in the sea, have been studied, and the amount of minute plants and animals —plankton—estimated by means of hauls with fine-meshed nets. The work was being closely followed by the Admiralties, meteorologists, and marine biologists of many nations.

REFERENCE was made in NATURE of Nov. 23, p. 814, to the press announcements of the award of the Nobel prize for physics for 1929 to the Duc de Broglie for his work on the undulatory theory of matter. This work was carried out by M. Louis de Broglie, a younger brother of the Duc de Broglie, and it appears that the award has been made to the former. Maurice François César, Duc de Broglie, it will be remembered, is himself a distinguished physicist who received the Hughes Medal of the Royal Society last year for his pioneer researches on X-ray spectra and secondary β-rays. Reverting to M. Louis de Broglie, it may be added that it was his work which led Schrödinger to his well-known equation which is the basis of attack of problems by wave mechanics. The first experimental verification that an electron behaves like a wave was made by Davisson, and Germer, who studied the scattering of electrons from a single crystal of nickel. They were working at the Bell Telephone Laboratories, Inc., New York, and reported their experiments in a letter which appeared in NATURE of April 16, 1927, p. 558; a more detailed statement appeared in the *Physical Review* for December 1927. The experiments of Prof. G. P. Thomson and others on the subject were somewhat later, and different methods were adopted.

DR. A. B. RENDLE, who retires from the post of Keeper of the Department of Botany in the British Museum in January next, was educated at St. Olave's Grammar School and St. John's College, Cambridge, and entered the Museum in 1888. By this time the collections which had been transferred from Bloomsbury in 1880 had been arranged, but there was still much to do, and Dr. Rendle then and there began his interest in the public gallery and index museum, the exhibits in which have been mainly his work. His systematic studies deal mainly with Monocotyledons, Apetalæ, and Gymnosperms, on which he has published more or less continuously for the past forty years; but he has also done critical work in other groups, for example, Convolvulaceæ and Urticaceæ. He was appointed keeper in 1906 in succession to G. R. M. Murray, who retired through ill-health before he was fifty. During Dr. Rendle's tenure of office the Department has probably doubled in size in every way. He was elected a fellow of the Royal Society in 1909.

THE keepership of a natural history department usually carries with it a number of non-official obligations, and Dr. Rendle has taken a pleasure in entering into these to the full. Amongst other activities, after serving on the Council of the Linnean Society, he became botanical secretary from 1916 until 1923, and president from 1923 until 1927. During this last period, the Society was undergoing certain changes which might have made for difficulties with a less experienced president. For the period 1894–1906, Dr. Rendle was head of the Botanical Department at Birkbeck College, and has always taken an interest in the teaching of botany, academic and otherwise. He has been president of several societies—South-Eastern Union of Scientific Societies, South London Botanical Institute (almost from its start), Quekett Microscopical Club—and has been honorary professor of botany to the Royal Horticultural Society for some years. After J. Britten's death in 1924, he added to his many duties that of editor of the *Journal of Botany*. His principal works are "The Classification of Flowering Plants", of which Vol. 1 appeared in 1904 and Vol. 2 in 1925, and the "Flora of Jamaica", with the late W. Fawcett; this latter began in 1910, and it is to be hoped that Dr. Rendle will be able to complete it. After his long reign as keeper he will doubtless appreciate the botanical opportunities which a well-earned retirement brings.

Mr. J. RAMSBOTTOM, deputy keeper of the department of botany since Nov. 1927, who succeeds Dr. A. B. Rendle as Keeper, entered the Department in 1910, after studying at Cambridge and Manchester. He was appointed to the section on fungi, which previously had not received the attention due to its importance. During the first part of the War, many

investigations were carried on in the Department, and later Mr. Ramsbottom was seconded to the War Office for service as protozoologist in Macedonia. His civilian days came to an end after about a year's service, and he was attached to the R.A.M.C.; he was mentioned three times in despatches and awarded the M.B.E. and O.B.E. The cryptogamic herbarium at the Museum has become more and more important since the War, and is likely to continue. Mr. Ramsbottom was president in 1924 and is general secretary of the British Mycological Society; he has been botanical secretary of the Linnean Society since 1923, and this year he is president of the Quekett Microscopical Club.

THE second of three windows placed in St. Ethelburga's Church, Bishopsgate, to the memory of the seventeenth-century navigator, Henry Hudson, was unveiled on Nov. 28 by Mr. A. Halsted, the American Consul-General in London. This window, like the first, is the gift of certain citizens of the United States. In it Hudson is shown exploring the Hudson River in the *Half Moon*, finding Red Indians welcoming his approach. His first voyage was made for a company of London merchants, and it was in St. Ethelburga's that Hudson and his crew made their communion on April 19, 1607, before going aboard. Nothing is known of him prior to that, but in the course of the succeeding years he made four voyages, first to Greenland and Spitsbergen, then to the coast of Novaya Zemlya, thirdly to the Atlantic coast of America, during which he explored the Hudson River a little farther than Albany, and lastly to Hudson Bay. He was not the discoverer of either the river, the straits, or the bay which bear his name, but he added much to the geography of North America. Preparing to return to England in the spring of 1611, a part of his crew mutinied, and Hudson with his son and seven others were turned adrift in an open boat, after which nothing more was heard of them. Like many other voyages, Hudson's were undertaken with the view of finding a northern passage to the East Indies.

DURING the recent meeting of the International Institute of African Languages and Culture, held in London, the members were entertained by the Government at a luncheon given at the Hotel Cecil on Nov. 28, when a large number of distinguished guests was present. The occasion was made notable by a speech from Lord Passfield, in which he paid a tribute to the value of anthropology in the administration of the affairs of a backward people. Every young man, he said, who goes out to take part in administrative work ought to receive very definite training in anthropology, and he went on to express the hope that the beginning which has been made in giving training of that kind may be increased and intensified. A pronouncement of so emphatic a character, coming from the head of the department in charge of the Dependencies in which the officers to whom he referred will have to carry on their work, cannot fail to stimulate the study of native institutions and intensify the interest taken in them by those who are preparing to enter the Colonial services.

IT may not be inapposite to point out, however, that facilities for training probationers for the Colonial services have long been provided by universities and other educational institutions of Great Britain, which have repeatedly urged upon those in authority the desirability and, indeed, the necessity that administrative officers should receive a grounding in anthropology before taking up their duties. Prof. Westermann, a director of the Institute, in thanking Lord Passfield for his encouraging speech, pointed out the utility of such an organisation as the Institute to traders, planters, settlers, administrators, educationists, and missionaries in helping them to the solution of the problems with which they are surrounded. It is unfortunately only too true that while, as Prof. Westermann pointed out, the vital interest in Africa is the African, the whole aspect of his life is threatened by the white man's activity. It cannot be too widely realised that only a sympathetic and well-informed administration, with a policy based on a study of native custom, can solve the problems upon which depend the whole political and economic future of Africa.

COMMANDER R. E. BYRD on Friday of last week made a successful flight from the Bay of Whales on the Ross Barrier to the South Pole and back. He returned in the early hours of Saturday morning, having accomplished the distance of about fifteen hundred miles without mishap. On the return journey, a descent was made for refuelling at a depot of petrol which had been placed on the Barrier 400 miles south of his base. Details of the flight and Commander Byrd's discoveries are still lacking, but his course, if straight, must have been approximately that of Captain Amundsen in his sledge journey in 1911. In order to cross the lofty Queen Maud Ranges, Commander Byrd must have risen to more than 10,000 ft. At that altitude, if the weather was clear, he should have seen the unknown eastern edge of the Barrier, hinted at by Amundsen, and also the course of the Queen Maud Ranges to the south-east. Sir Hubert Wilkins is also in the Antarctic at his base at Deception Island, South Shetlands, where he is preparing for his contemplated flight westward along the Pacific edge of the Antarctic continent to the Ross Barrier.

WHILE it may be one thing to have proved an oilfield to be worth working from a commercial point of view, it may be quite another matter to exploit it successfully if questions of title to concessions, exploration and development rights, royalties, refining practice, employment of nationals, and so on, founded on insecure legal codes, are constantly raised at the slightest whim of governments. Such matters of higher policy, particularly in the case of companies operating in foreign territories, call for administrative ability of no mean order, and few, even within the oil industry, appreciate the extent of the diplomatic workings necessary, both at home and abroad, to secure uninterrupted operations. Instance the country inexperienced in oil production suddenly finding itself the possessor of newly discovered petroleum resources; in the general scramble for titles, probably exaggerated

optimism, and public dreams of quickly gotten wealth, a number of laws, loose in construction, impossible of rational interpretation, are passed; as time goes on and developments promise well, various conditions and petty restrictions are imposed, either with the view of diverting more money into the national exchequer, or of giving the government (more probably its favoured officials) active participation in the affairs of the company.

A KIND of communal possessive instinct is manifest, strengthened in proportion as the industry grows; the attitude of disinterested complacency at the pioneer stage, while the oil company was spending money and earning none, rapidly changes to one of mere tolerance and desire to profit the moment success is assured; the public is urged to protect its rightful interests; the cry of nationalisation of internal resources is raised, and everything done to make conditions as difficult as possible for the harassed company officials. Usually, the proportion of local staff employed is compulsorily raised until the company finds itself flooded out with superfluous, inefficient labour; then long and protracted negotiations are undertaken between government and executive to find a policy which will placate the former and yet make it possible for operations to continue on a paying scale. These are among some of the more complex problems propounded by immature oil legislation, and Sir Arnold Wilson was right when he stated in a paper read before the Institution of Petroleum Technologists on Nov. 12 that unsuitable laws retard, and good laws encourage, developments of the oil industry, especially in countries such as Central and South America, where the evils of defective law and inconsistent legislation have often had to be reckoned with by the concession hunter or lease-holder.

THE compound for which the handy abbreviation of 'S.U.P. 36' has fortunately been adopted, is the symmetrical urea of para-benzoyl-para-amino-benzoyl-amino-naphthol 3 : 6 sodium sulphonate; it was introduced by McDonagh, in the belief that it would prove of value in therapeutics by stimulating the tissues of the host to overcome various acute microbial infections. R. M. Pearce (*Brit. Med. Jour.*, Oct. 12, pp. 663 and 831; 1929) has recently described its use in influenza: in a series of more than eighty cases, every alternate patient was given 0·005 gm. S.U.P. 36 intramuscularly when the onset had occurred within the preceding forty-eight hours, and a further dose of 0·0075 gm. if necessary on the fourth day. The uninjected cases served as controls. It was found that the duration of the pyrexia, of the headache and muscular pain, as well as the total duration of the illness, were about halved by the injection of S.U.P. 36. J. S. Hall (*ibid.*, p. 831; 1929) has also found it of value, in doses up to 0·01 gm., in a variety of conditions, including the severe vomiting of pregnancy, acute pyelitis, cystitis and mastoiditis, osteomyelitis and broncho-pneumonia in children. The compound, however, does not act as a preventive if injected when no acute infection is present. Further details of its action and uses are given in a little brochure published by The British Drug Houses, Ltd., Graham St., London, N.1, who prepare the compound, manufactured by British Dyestuffs Corporation, Ltd., for medical use: it is issued ready for intramuscular injection in isotonic solution in ampoules or rubber-capped vaccine bottles.

THE maximum power which may be radiated by broadcasting stations was limited to a hundred kilowatts by the International Consultative Committee at the Hague Conference. An unfortunate consequence of this decision is that this enormous power is regarded by many as the standard which should be aimed at when constructing a national broadcasting station. Some of the European States which are now constructing broadcasting stations are proposing to use very high powers, notwithstanding that the use of crystal receivers is now dying out, and that the number of listeners using valve sets is rapidly increasing. So far as reception in Britain is concerned, there is little interference at present by foreign transmissions, but in the immediate future when more giant stations are constructed abroad trouble due to this cause will be serious.

IN the early days of broadcasting, both in Great Britain and abroad, the stations provided about one kilowatt to the aerial. According to the *Wireless World* for Nov. 27, Germany was the first country to increase the power of its stations. As other countries began to build transmitters the natural tendency was to equal or raise the four kilowatt standard set by Germany. Five and ten kilowatt broadcasting stations became quite common. Germany is now considering a scheme for installing new high-power stations in addition to the present transmitters, and proposes to combine them into groups. The lower-power transmitters will operate on the national wave-length in conjunction with a high-power station. If this scheme is adopted, the German transmitters will once more dominate Europe, and other States will be stimulated to follow the German example. As a rule, the higher the power of a station the more costly is its construction. It will be very difficult, therefore, to modify European broadcasting in the future should this become necessary, owing to an excessive number of high-powered stations.

DURING last year immense strides were made in the development of broadcasting in Japan. Six modern broadcasting stations have been opened, with the idea of bringing as many listeners as possible within crystal range of some station. The new stations are each rated at 10 kilowatts, and are housed in new buildings so as to leave the original transmitters still available in case of emergency. All call signs in Japan are given out in English, and consist of four letters commencing with J.O. and ending with K. For example, J.O.A.K. stands for Tokyo, and J.O.C.K. for Nagoya. The entire broadcast wave-length lies between 350 and 400 metres. We learn from *Electrical Communication* for October that the equipment of all the stations has been imported from England. Sendai (J.O.H.K., 389·6 m.) is the chief town in the north of the main island. It is here that Prof. Honda's laboratory for metallurgical research is situated.

Every physicist and electrician knows the important work that he has done in connexion with cobalt magnet steel, now known as 'K.S. steel', work that has proved a great boon to the designers of electrical apparatus. For listeners outside Japan this station is the most favourably situated. New Zealand has reported excellent reception. Owing, however, to the mountainous nature of the country, the signal strength from any station varies considerably with its locality. There are one or two large cities situated quite close to a broadcasting station where reception is sometimes very poor. It is probable, therefore, that it will be found advisable to supplement the present main stations by small relay stations of two kilowatt capacity, when the demand gets greater.

THE study of the habits and psychology of the great apes must always be of supreme interest for their human relatives. Such study in the Old World has been provided for by the French station at Kindia, in Africa, where the apes can be observed in conditions approaching those of their natural life and in a favourable climate. According to a *Daily News Bulletin* issued by Science Service, Washington, D.C., a similar station, in which natural conditions will be copied so far as possible, is to be created on a 200-acre plot near Orange Park, Florida, under the auspices of Yale University. This great scientific ape-breeding farm has been made possible by a gift of 500,000 dollars from the Rockefeller Foundation.

UNDER the Boiler Explosion Acts of 1882 and 1890, the Board of Trade is authorised to hold inquiries into explosions of steam boilers and steam apparatus in Great Britain, and 62 such inquiries were held during 1928. Some of the accidents resulted in injuries to persons, of whom seven died, and also in great financial loss. The explosions included accidents to marine and land boilers, steam pipes and valves, bakers' steam-heated ovens, economisers, drying cylinders, etc. At the beginning of the present year, during the severe frost in February, many explosions of heating apparatus took place, and those which occurred in churches, schools, and other institutions were the subject of inquiry. In every case it was shown that ice forming in the pipes had choked the system and that the safety arrangements had become inoperative. Explosions in private houses were reported in the Press at the time, and it is probable there were a large number of such failures. With the approach of winter, it cannot be too strongly impressed upon all who have charge of steam and hot-water heating systems that the safety valves or safety discs should be placed on the boilers themselves and not in the heating pipes at some distance away. Practically every accident to heating apparatus which has come to our notice would have been prevented had the safety appliances been so placed.

AT a recent meeting of the New York Electrical Society, Mr. E. W. Stearns gave some particulars of the great suspension bridge now being built over the Hudson River, which will connect New York City and New Jersey. The bridge will be ready for use in 1932, and when completed will be by far the largest suspension bridge in the world, having a span between the towers of 3500 feet. The two towers, each 635 feet high, will carry a weight in cables alone of 28,000 tons, the cables containing more steel wire than the next seven largest suspension bridges combined, the Brooklyn, Williamsburgh, Manhattan, Detroit, Philadelphia, Bear Mountain, and Poughkeepsie bridges. Made of steel wire with a tensile strength of 230,000 pounds per sq. in., each of the four main cables will contain 26,474 wires made up of 61 strands of 434 wires each. To squeeze the cables into circular shape a squeezing jack with hydraulic cylinders will be placed around the cable and this will bring a pressure of 400 tons to bear on the cable. Sufficient elasticity is incorporated into the design of the towers and the bridge to allow of a sag of ten feet, but the sag under normal loading will not be more than four feet.

THE twelfth of the series of the Rockefeller Foundation, New York, devoted to "Methods and Problems of Medical Education", is given up to articles by specialists in charge of "Departments and Institutes of Röntgenology and Radium Therapy". This is a very valuable compilation, and it appears opportunely when big movements are afoot for the development of radiology in medicine. The book is essentially a presentation of how this subject is dealt with the world over; the various departments and organisations are described in detail with lists of personnel and occasionally estimates of cost of running such departments. Such a publication has a twofold value. In the first place, the reader can gather the extent to which radiological methods are at present used in everyday diagnosis and treatment of patients; and in the second place, those who are concerned with the initiation or development of departments of this kind will have at their command a mass of information which should be of the greatest scientific and economic service to them.

AN account of the modern methods of fishery research as undertaken by the biological laboratories and fisheries institutes on the coast of the North Sea and Baltic is given in Lief. 12, Teil $1.e_1$ (Fischereibiologie by W. Schnakenbeck) of Grimpe and Wagler's "Die Tierwelt der Nord- und Ostsee" (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1928). After an introduction and brief historical survey, the author proceeds to describe the various nets, dredges and trawls in use for both fishes and invertebrates, including plankton nets and water bottles for the smallest organisms, and, for sampling the bottom, the 'grab'. The most important methods of research are then briefly noted, particularly age-determination and the marking of fishes, and the study of animal communities at the bottom in connexion with fish food, besides method of plankton research. There are good illustrations of the research vessels employed by the laboratories and institutes in Heligoland, Denmark, Sweden, Norway, Scotland, and England, also of the nets, dredges, water bottles, and grab, figures showing representative bottom communities and numerous maps and diagrams. The whole forms a useful introduction to methods of fisheries research.

THE Thomas Lowe Gray Lecture of the Institution of Mechanical Engineers will be delivered on Jan. 3 at 6 P.M. by Eng. Vice-Admiral R. W. Skelton, who will take as his subject "Progress in Marine Engineering".

LORD BLEDISLOE, president in 1922 of Section M (Agriculture) of the British Association and Parliamentary Secretary to the Ministry of Agriculture from 1924 until 1928, who has for many years identified himself with agricultural interests, has been appointed Governor-General of New Zealand in succession to General Sir Charles Fergusson, whose term of office expires early next year.

PROF. G. ELLIOT SMITH will deliver a lecture on Java in the Great Hall of University College, Gower Street, W.C.1, on Monday, Dec. 9, at 5.30 p.m. Prof. Elliot Smith visited Java last summer when, acting as one of two representatives of the British Government, he attended the Pacific Science Congress held at Batavia in May last. The lavish hospitality of his hosts gave Prof. Elliot Smith every opportunity of seeing whatever was worth seeing in their colony. He visited the principal sites of archæological interest, saw something of life in the native protectorates, including the courts of the sultans, and also visited the island of Bali, interesting from the peculiar nature of its people, its culture, and its religious ceremonial. Prof. Elliot Smith's lecture will cover an attractive and, to the average Englishman, little-known field.

THE first S. M. Gluckstein Memorial Lecture of the Institute of Chemistry will be delivered by Dr. Leslie H. Lampitt at the Institute on Friday, Dec. 13, at 8 P.M. Dr. Lampitt has chosen for his subject "The Chemist and Commerce". The late S. M. Gluckstein, a director of Messrs. J. Lyons and Co., Ltd., read before the London and South-Eastern Counties Section in October 1927 a paper entitled "Chemistry and Dividends", in which he gave an account of the development of the chemical staff and laboratories of his company, illustrating the bearing of science, and particularly chemistry, on the management of a large industrial undertaking. The laboratory staff of the company is now 72 chemists and assistants, who are accommodated in the laboratories at Kensington, opened this year, of which Mr. Gluckstein, who died on Aug. 29, 1928, did not live to see the completion. In memory of the Director who had taken so great an interest in their work, the staff of the laboratory, of which Dr. Lampitt is the head, offered the Council of the Institute a sum of approximately £200 to administer this fund for the provision of an annual lecture, the purpose of which is to show the bearing of science on industry, particularly in various fields of chemical activity. The lecture will be open to members of other societies and to the public.

WE have received vol. 6 (1928) of the *Transactions of the Institution of Chemical Engineers*. This contains the presidential address of Sir Alexander Gibb on the economics of power as applied to chemical engineering, papers on magnetic separation, the combustion of powdered coal, treatment of beet sugar factory effluents, fluid jets, electrodeposition of rubber, and several papers on drying.

FOR the hundred and tenth annual meeting in Davos of Schweizerische Naturforschende Gesellschaft a 'Festschrift' of some twenty articles was produced (B. Schwabe and Co., Basel). All the articles have a bearing on Davos and they are of a varied nature. Several are meteorological, one of them dealing with the intensity of the insolation. Others treat of the geology, flora, birds, and butterflies of the district. Two articles are descriptive of the research institutions of Davos and five treat of medical subjects germane to the district. The volume has a number of photographic illustrations.

THE International Baltic Geodetic Commission held its fourth session at Berlin in September last year. All the States adjoining the Baltic except Russia were represented. The proceedings are now published in *Verhandlungen der Baltischen Geodätischen Kommission* (Helsinki, 1929). The daily proceedings are recorded, and several of the more important papers are printed at length with maps. All of the States concerned provided papers on some aspect of their geodetic work, and several States, notably Denmark, contributed accounts with charts of the present state of triangulation. The next meeting of the Commission is to be in Copenhagen in 1930.

THE Department of Agriculture and Stock of Queensland has recently published a useful manual entitled "Pests and Diseases of Queensland Fruits and Vegetables", by Messrs R. Veitch and J. H. Simmons. This handbook supplies the want for a trustworthy account of the commoner pests of Queensland fruits and vegetables and, at the same time, provides a short introduction to the elements of entomology and plant pathology. It can be recommended as a good practical account of the subject and its value is much enhanced by sixty-one excellent plates, both black-and-white and coloured, which have been executed in Australia. The book bears the name of the Government Printer, Brisbane, 1929, but no price is stated.

THE International Society of Experimental Phonetics has arranged for the following official organs to be sent to its members at reduced prices: *Zeitschrift für Experimentalphonetik*, quarterly, 5*s*. (instead of 10*s*.); *Comptes rendus de la Société Internationale de Phonétique expérimentale*, annually, no charge; *Bulletin of the International Society of Experimental Phonetics*, annually, 1*s*.; *Sprachneurologische Mitteilungen*, quarterly, 4*s*. (instead of 6*s*.); *Archives Neérlandaises de Phonétique expérimentale*, annually, 6*s*. 7*d*. or 4*fl*. (instead of 5*fl*.); *Archiv für Psychiatrie u. Nervenkrankheiten*, 20 per cent reduction. All persons—as well as libraries, institutes, corporations, business firms, etc.—who are interested in experimental phonetics may become members of the Society. Only experimental phoneticians of acknowledged standing may be members of the council. Applications for membership, accompanied by the fee

of 10*s*., may be sent to the president, Prof. E. W. Scripture, 25 Howard Road, Coulsdon, Surrey, England.

MESSRS. Dulau and Co., Ltd., 32 Old Bond Street, W.1, have just issued Catalogue No. 172 of upwards of 2000 second-hand books of science classified under the headings of horticulture, plant collecting, herbals, and general botany; local floras; geology, mining, palæontology, etc.; ornithology; general natural history, including entomology, mammalia, fishes, invertebrata, mollusca, etc.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A lecturer in engineering at the Kenrick Technical College, West Bromwich—The Director of Education, Education Offices, West Bromwich (Dec. 14). A chemical laboratory assistant at the Royal Arsenal, Woolwich—The War Department Chemist, B.47, Royal Arsenal, Woolwich, S.E.18 (Dec. 14). Temporary inspectors under the Department of Agriculture for Scotland—The Establishment Officer, Department of Agriculture for Scotland, York Buildings, Queen Street, Edinburgh (Dec. 14). A part-time lecturer in mathematics at Birkbeck College—The Secretary, Birkbeck College, Fetter Lane, E.C.4 (Dec. 16). A Paterson research scholar in the Cardiographic Department of the London Hospital—The House Governor, London Hospital, E.1 (Dec. 17). A guide-lecturer and professional assistant at the Science Museum, South Kensington—The Director and Secretary, Science Museum, South Kensington, S.W.7 (Dec. 21). An investigator at the Royal Aircraft Establishment for research work in connexion with the electro-deposition of metals—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (quoting A. 388) (Dec. 21). A permanent inspector under the Department of Agriculture for Scotland—The Establishment Officer, Department of Agriculture for Scotland, York Buildings, Queen Street, Edinburgh (Dec. 21). Two assistant entomologists under the Division of Economic Entomology of the Commonwealth Council for Scientific and Industrial Research, for work on the Buffalo Fly Problem—F. L. McDougall, Australia House, Strand, W.C.2 (Dec. 30). A principal of the Central School of Arts and Crafts, Southampton Row, W.C.1—The Education Officer (T.1), County Hall, Westminster Bridge, S.E.1 (Jan. 20). A resident research fellow at Lady Margaret Hall, Oxford—The Hall Secretary, Lady Margaret Hall, Oxford. A lecturer in geography at St. Mary's College, Strawberry Hill—The Principal, St. Mary's College, Strawberry Hill, Middlesex. A chief lecturer in the Electrical Engineering Section of the Engineering Department of the Halifax Municipal Technical College—The Principal, Municipal Technical College, Halifax. An evening lecturer in refrigeration at the Borough Polytechnic Institute—The Principal, Borough Polytechnic Institute, Borough Road, S.E.1. A temporary junior assistant for a Government Laboratory—Z. E., c/o Charles Barker and Sons, Ltd., 31 Budge Row, E.C.4.

Our Astronomical Column.

Solar Activity.—The temporary revival of solar activity shown during the last few weeks has been continued by the recent appearance of two other large groups of spots. One of these was a big regular spot of about 1000 millionths of the sun's hemisphere, and was therefore a conspicuous naked-eye object. This spot was the return of a complex stream, No. 13 in the list given in NATURE, Nov. 9, p. 737. The other group (No. 15) represented a new outbreak in the place of No. 12. The following table is continued from the note in our issue of Nov. 9 :

No.	Date on Disc.	Central Meridian Passage.	Latitude.	Max. Area.
15	Nov. 21–Dec. 4	Nov. 27·9	13° N.	900
16	Nov. 24–Dec. 6	Nov. 30·3	16° N.	1000

Spectrohelioscope at Greenwich.—A spectrohelioscope is being installed at the Royal Observatory, Greenwich. The instrument, which has been lent by the Mt. Wilson Observatory, is one of several constructed according to Dr. G. E. Hale's design in the observatory workshops at Pasadena. A description of this ingenious adaptation of the spectroscope, and the observations it is possible to make with it, will be found in various contributions made to NATURE by Dr. Hale during the past few years (see July 3, Supplement, 1926; May 14, 1927, p. 708; April 28, 1928, p. 676).

Jupiter.—Fourteen months ago Rev. T. E. R. Phillips announced the appearance of a series of small spots in the southern hemisphere of Jupiter which had such a high westward velocity that their apparent period of rotation was $9^h\ 59^m$, the highest value on record. In *Circular* No. 79 of the British Astronomical Association, he describes some recent observations made by Mr. A. Stanley Williams at St. Mawes, Cornwall. They refer to some spots on the south edge of the North Temperate belt, which have the abnormally short rotation period of $9^h\ 48^m\ 49^s$, indicating a rapid eastward motion on the planet's surface. There is, therefore, a difference of more than 10^m between the rotation periods of the spots of 1928 and the present spots. It is further noted that spots in the same latitude as the present ones were seen in 1880, 1891, 1892. These also gave an unusually short period of rotation.

Stellar Spectroscopy at Dominion Observatory, Victoria.—The *Publications* of the Dominion Observatory, vol. 4, Nos. 12 and 13, contain two interesting researches on spectroscopic binaries. No. 12, by R. N. van Arnam, treats of the star β Cephei, which is of mag. 3·3, type *B*1. The period is 0·1904843 day. Treating the change in radial velocity as due to orbital motion, the orbit elements appear to have changed notably between 1919 and 1922. The semi-amplitude of the velocity range changed from 13·1 to 9·5 km./sec., the difference being eight times the probable error; $a \sin i$ changed from 34,043 km. to 24,606 km. The symmetry of the velocity curve indicates that if the change in radial velocity arises from orbital motion the orbit is appreciably circular.

No. 13, by W. E. Harper, describes the orbits of two spectroscopic binaries of unusually high eccentricity. Boss 4177, mag. 5·72, type *A*o, has a period of 4·951 days and eccentricity 0·511; the semi-amplitude of the velocity range is 16·28 km./sec.; only one spectrum is visible. H.R. 7338, mag. 6·19, type *A*o, shows the secondary spectrum faintly; the minimum mass of the system is twice that of the sun, divided in the ratio 1·180 to 0·844; the period is 10·3932 days, and the eccentricity 0·520.

Research Items.

Anthropology and Blood-Groups.—In *Man* for November, Dr. H. Woollard and Dr. J. B. Cleland discuss the evidential value of the blood-groups in anthropology as an indication of race. Their view differs fundamentally from that now generally held, and is primarily based upon investigation of the blood-group in the Australian aboriginal. It has been observed that the *A* group is the most frequent in the aborigines who belong to Central and South Australia, and when the results are those of natives whose purity is above suspicion, it is found that the Australian aboriginal contains no *B* factor. On this evidence it has been suggested that the Australian has Nordic affinities, while other investigators, finding the evident discrepancies in the group percentages of closely related peoples, have been tempted to ignore blood-groupings. Obviously percentage grouping is only one racial character which no more suffices to distinguish race than any other single character. Taking the evidence afforded by the blood-grouping of the anthropoids, the American Indian, and the Australian, it is here suggested, contrary to the view hitherto put forward, that the original human family contained all four groups. Instead, then, of this single anthropological character being expected to stamp each variety of man, the problem is rather to explain how the existing varieties of man obtained their present percentage, and indeed how a human type escaped an inheritance of all four groups and comes to possess one only. Thus the high frequency of the *A* factor in the Australian aboriginal implies no close affinity with Nordic man, who also possesses a high percentage of the *A* factor. The constitution of a grouping such as that in the Australian would force the assumption that their ancestors started with this genetic constitution, that they were few in number, and that they have lived for a long period in isolation.

Vaccination against Anthrax.—In the current number (Vol. 62, Parts 6-10) of the *Rendiconti* of the Royal Lombardy Institute of Sciences and Letters, Dr. Mario Mazzucchi describes the results of experiments on a new method of vaccination against anthrax. The procedure followed differs fundamentally from that used by Pasteur, as it employs, not attenuated anthrax bacilli, but virulent germs and spores. Only a single injection is made, and twelve days later immunity from the disease is so complete that the treated animal is able to withstand an injection of anthrax organisms sufficient to produce fatal results in control animals within 40-60 hours. The tests were made at both the Istituto Sieroterapico of Milan and the Stazione Sperimentale di Zooprofilassi in Rome, and were carried out on goats, sheep, and cows, always with the same result—that the new vaccine is far more efficacious than the three Pasteur vaccines with which it was compared. The observations made by Dr. Mazzucchi indicate that it is necessary in experimental work of this kind to bear in mind that the resistance of an animal to anthrax may be of any of the following forms: (1) Individual resistance, common to all animals, no matter what the species; (2) regional resistance, which appears to be the greater with animals accustomed to the wild state; (3) resistance from natural acquired immunity, not infrequent in animals which live in infected zones and may have contracted infection and undergone spontaneous cure; (4) a complex immunity consisting of type (3), reinforced by the slight action of an attenuated vaccine.

Tidal Zone Fauna in Sand and Mud.—Mr. A. C. Stephen, in his "Studies on the Scottish Marine Fauna: the Fauna of the Sandy and Muddy Areas of the Tidal Zone" (*Trans. R. Soc. Edinburgh*, vol. 56, Pt. 2, No. 14, 1929), continues his examination of the fauna of the intertidal bays which was begun in the Island of Cumbrae in 1926 and is now extended to various other areas on the Ayrshire coast, Firth of Clyde, south coast of Moray Firth, Aberdeenshire coast, St. Andrews Bay, and the Firth of Forth. Mollusks and polychætes are specially dealt with, only a few species being common and widely distributed: such are *Tellina tenuis*, *Nephthys cæca*, *Donax vittatus*, *Cardium edule*, and *Macoma baltica*. The two first are characteristic of clean sand, and, locally, also *Donax vittatus*, the two last living on muddy ground or black and strong smelling sand. In certain areas the two types intermingle, the nature of the soil evidently being an important factor when dealing with distribution. Each species has a region of maximum concentration. *Tellina tenuis* is almost always most abundant at low-water mark, gradually decreasing towards high-water mark, *Macoma baltica* and *Cardium edule* having their maxima between tide-marks. A further research into the food of these invertebrates would be of great value, and it is to be hoped that this will be forthcoming.

Influence of Light on Larval Ascidians.—Experiments with larvæ of *Symplegma viride* were made last year at the Tortugas Laboratory by Mr. Caswell Grave. This year a note by the same author (*Year Book* No. 27 of the Carnegie Institution of Washington, 1928) shows the response to light stimuli by *Polyandrocarpa tincta*, a species closely related to *Symplegma*. The small larva is liberated in large numbers and its free-swimming period is relatively long (transforming in the course of a day under laboratory conditions). Experimentally, the majority of the larvæ can be induced to metamorphose and attach themselves in about 70 minutes by subjecting them soon after being set free to alternate periods of light and darkness, a typical instance being 25 or 30 one-minute 'doses' of light, each followed by a one-minute 'dose' of shadow. The light was ordinary diffuse light from the laboratory windows, allowed to come only from the east, other sources of light being blocked, and the experimental vessels were covered by tumblers wrapped in black paper for the period of darkness. Controls exposed to the same light but without periods of darkness took several hours to metamorphose. The rhythmic alternation of the periods of light and darkness is of importance, intensity of light making little or no difference. The natural habit of the free-swimming larva is to swim up and down between the surface when it is light and the bottom when it is dark, until a "final stimulus to attachment and metamorphosis is released".

The Trematode Family Schistosomidæ.—This family is the subject of a useful and compact synopsis by E. W. Price (*Proc. U.S. Nat. Mus.*, vol. 75, Art. 18, 39 pp., 1929), who has carefully assembled the descriptions of the known genera and species, has prepared keys for aiding their identification, and clear illustrations to show their diagnostic characters. Three new genera are founded—*Heterobilharzia*, for some male worms from the mesenteric veins of the North American lynx; *Paraschistosomatium*, of which the female only is known from the portal vein of a bird from Texas; and *Microbilharzia*, from the mesenteric veins of North American birds.

Encystment in Rotifers.—David L. Bryce (*Jour. R. Micr. Soc.*, vol. 49, Pt. 3) records observations on

the encystment of three Bdelloid rotifers. He states that no evidence of encystment exists in rotifers other than Bdelloids, but suggests that it is widespread in this order, and is correlated with the habits. A large proportion, probably the great majority, of Bdelloids have alternate periods of activity and of dormant existence according as the moss in which they live is wet or dry. So long as the moss is wet they are active and multiply, but when the moss begins to dry they retract their extremities within the central portion of their bodies, reducing their bulk as much as possible, and pour out a secretion which completely covers them and hardens to an air-proof coating. When the moss is again wetted by dew or rain, the coating is dissolved and the rotifer renews its activity. The author refers to the flimsy character of the envelope, "that it would afford any protection against desiccation is not known". He suggests that the reason why similar examples of encystment have not previously been detected is perhaps that few observers have kept these rotifers alive from day to day in almost minute quantities of water. That the short supply of water was the reason for the encystment in these cases can scarcely be doubted.

Japanese Calcareous Sponges.—Only six species of calcareous sponges had been recorded from Japan until Prof. Sanji Hōsawa took up the study of this special group, and now he has added fifty-one more species from this region, no less than forty-seven of which are new to science. Some of these have already been described by the author (1916, 1918), who in a recent memoir, "Studies of the Calcareous Sponges of Japan" (*Journal of the Faculty of Science*, Imperial University of Tokyo, Section 4, Zoology, vol. 1, part 5, January 1929), revises what has been written by previous authors, and gives detailed descriptions of those forms which he has himself observed. The specimens were furnished by various collections from many localities, in depths ranging from shallow water to 572 metres. Thirty-four new species are described in this paper, and these are for the greater part preserved in the museum of the Zoological Institute of the Science Faculty in Tokyo. There are twelve plates with photographs of the individual sponges, and beautifully executed coloured figures showing sections with details of the skeleton, and there are in addition many text figures of the spicules. The new species include three *Leucosolenia*, one *Dendya*, one *Leucaltis*, one *Sycetta*, seven *Sycon*, one *Grantessa*, three *Vosmæropsis*, two *Grantia*, two *Ute*, and thirteen *Leucandra*.

Origin of Cultivated Dahlias.—In an interesting paper, Mr. W. J. C. Lawrence (*Jour. Genetics*, vol. 21, No. 2) has given an account of genetical and cytological work on dahlias. Mexico and Central America is the home of this genus. Three species are found to be tetraploid ($2n = 32$), while *D. Merckii* has 36 chromosomes and *D. variabilis*, the common dahlia, is confirmed as having 64 chromosomes, an octoploid number. It was figured so early as 1615, and was probably grown as a garden plant in Mexico long before its introduction into Europe. Considerable evidence is brought in favour of the view that this octoploid species arose as a cross between two tetraploids, the hybrid being sterile but later producing a fertile form with twice as many chromosomes. It is found, for example, that ten species fall into the ivory-magenta-purple colour series, while four others are ivory-yellow-scarlet, while *D. variabilis* alone has factors belonging to both series. The inheritance of the *Y* factor for yellow flavone is, moreover, tetrasomic, resulting from random assortment of four homologous chromosomes. In the reduction division, associations composed of two, four, six, and eight chromosomes can be seen, apparently resulting from the earlier conjugation of homologous chromosomes in synapsis. No more striking case could be found of the way in which correlated cytological and genetical investigations throw light on the origin and history of cultivated forms, and it is to be hoped that these researches will be carried further.

Bibliography of Genetics.—There has recently appeared a work which should prove of considerable value to plant breeders and others interested in the subject. This is the "Bibliographical Monograph on Plant Genetics, 1900–1925", by H. Matsuura, published by the Tokyo Imperial University—a large octavo volume of 500 pages. The greater part of the work gives a résumé of genetical researches under the heading of the various genera arranged in alphabetical order. The geneticist has only to look up the genus, and he will at once find a succinct account of what has been already done, with full references to the original papers in the bibliography which forms the second part of the work. There can be few students of the subject who have not frequently experienced the need of such a work, and they will be grateful to Mr. Matsuura for the immense labour that has gone into its compilation. It can be obtained in London from Messrs. Dulau and Co. of Bond Street, for the moderate price of 10*s*. 6*d*.

Non-Marine Mollusca of Oregon and Washington.—Unlike the marine, which have been closely studied, and the literature of which is obtainable in comparatively compact form, the non-marine mollusca of the States of Oregon and Washington have been relatively neglected and their literature dispersed in scattered papers. This has now been remedied by the publication of a monograph by Junius Henderson (*Univ. Colorado Studies*, vol. 17, No. 2). Considerable material for the purpose was obtained on expeditions sent out by the University of Colorado Museum, whilst the author himself visited personally 225 widely distributed localities in the two States. The contents of other collections and past records have also been drawn upon. As a result some 186 species are recorded and figured in text illustrations, every endeavour having been made to render the identifications and synonymy correct and to bring the nomenclature up-to-date. A useful index has been provided.

Bibliography of Seismology.—In the spring of 1926, the Eastern Section of the Seismological Society of America began the publication of a valuable bibliographical bulletin of works relating to earthquakes. The bulletin was issued quarterly under the editorship of Mr. E. A. Hodgson, and was distributed in a immeographed form to the members of the Eastern Section as well as to various scientific journals. It was afterwards reprinted in the *Bulletin* of the Seismological Society. It has now been decided to continue the previous lists in a new series entitled "Bibliography of Seismology", the first part of which (for Jan.-Mar. 1929) appears under the same editorship as before in the *Publications* of the Dominion Observatory, Ottawa. It contains the titles (with an occasional brief abstract) of one hundred papers.

Raman Effect.—The amount of light that is scattered by a fluid without change in wave-length increases enormously when the substance is in the critical state. Raman himself suggested that an analogous increase occurred with the modified secondary radiation from carbon dioxide, but W. H. Martin afterwards obtained negative results with a mixture of phenol and water (see NATURE, Oct. 6, p. 506: 1928). The question is important, and has now again been attacked by S. L. Ziemecki and K. Narkiewicz-

Jodko, in Warsaw. Their work, which is outlined in *Die Naturwissenschaften* for Nov. 8, was done with the critical mixture of isobutyric acid and water at 24° C., with a powerful mercury arc of special construction for the primary source. The Raman lines due to the acid were found to be present in the scattered light, but their intensity was certainly not more than some 30 per cent above normal, and even this apparent increase may have been due to a heavy continuous background in the secondary spectrum. They point out that this furnishes an experimental proof that the Raman radiation is not coherent. Two further papers on the Raman effect have also appeared in recent issues of the *Indian Journal of Physics*, the third number of the current volume containing an account of an extended series of observations on modified radiation, by S. Venkateswaran and A. S. Ganesan, and the fourth number a useful summary and bibliography of 150 papers on the subject, by Dr. Ganesan.

International Temperature Scales.—The importance of having an international temperature scale for high temperatures is admitted by every chemist and physicist. The international temperature scale adopted in 1927 by the General Conference of Weights and Measures, representing thirty-one nations, is intended to reproduce, as closely as can be done with our present knowledge, the Centigrade thermodynamic temperature scale—the Kelvin scale. In this scale the temperatures of melting ice and of condensing water vapour, when both are under the pressure of one standard atmosphere, are numbered 0° and 100° respectively. This scale would be exactly realised with an ideal gas in a perfect gas thermometer. In practice it is closely realised by several of the permanent gases. The gas thermometer, however, is inconvenient for ordinary use. In practice, the results of the best gas thermometer determinations have been made permanently available by determining the freezing and boiling points of various pure metals up to the melting point of palladium, which is about 1550° C. These thermometric fixed points can be used in defining practical temperature scales with the help of convenient interpolation instruments. We learn from a paper on temperature scales by W. F. Roeser, published by the U.S. Bureau of Standards (*Research Paper*, No. 99), that the new scale (1927) is the fourth temperature scale used by the Bureau of Standards since 1912. His purpose was to determine how much change it was now necessary to make so that these scales could be compared with one another. The experimental results are highly satisfactory and show that the maximum difference in the temperature determined by the four scales is only a fraction of a degree Centigrade. The difference between the temperature of the freezing point of copper (1083°) and that of gold (1063°) is 20° C., with a maximum inaccuracy of less than the half of one per cent.

The Calculation and Interpretation of Parachors.—Some years ago S. Sugden showed that the product of the molecular volume by the fourth root of the surface tension of a liquid, called the *parachor*, might be expected to give a molecular volume at temperatures at which the liquids have the same surface tension. This was divided among the atoms of the compound, and the parachor of a compound could then be represented as the sum of the parachors of its atoms and certain constants characteristic of the types of linkages in the molecules. This has led to many interesting results from the point of view of the structure of compounds. In the September issue of the *Journal of the Chemical Society*, S. A. Mumford and J. W. C. Phillips show by an extensive survey of the data that, although the atomic constants of Sugden are probably very nearly correct, the change due to an increment of CH_2, and hence of carbon and hydrogen values, which they propose, leads to greater accuracy in the calculated parachors, especially in the case of compounds of high molecular weight. In their scheme also the parachor loses its strictly additive character and becomes definitely constitutive, stresses due to spatial arrangement of, and electrostatic influences between, atoms and groups in a molecule being accompanied by well-defined parachor variations. If these conclusions are substantiated, the value of the parachor method will be increased rather than diminished, since it will be able to throw still more light on the structure of compounds.

Decomposition in a Crystal.—Some very striking results have been obtained by Dr. J. Colvin and Mr. Hume in a study of the process of dehydration in crystals of potassium hydrogen oxalate hemihydrate, $2KHC_2O_4 . H_2O$ (*Proceedings of the Royal Society*, November, p. 635). This substance forms transparent plates of somewhat indefinite form, and decomposition, when it occurs, usually starts at an edge, where it is first evidenced by the appearance of a black dot. The dot then increases in size, and grows as a black area bounded by lines which are parallel, in general, to edges of the crystal. The rate of advance of the black edge in any particular direction can be followed with ease by means of a travelling microscope, and is constant, but occasionally an edge will halt for a few minutes, and then start off again with the same speed as before. The steady rate of advance depends upon the direction in which the reaction is proceeding into the crystal, and varies considerably from one batch of plates to another, but has in all cases a large positive temperature coefficient, equivalent to a heat of activation in the neighbourhood of forty kilocalories.

Bearings and Lubrication.—The commonest component of machinery of all kinds is the journal revolving in a bearing, and the design, construction, lubrication, and maintenance of such bearings present many problems to the engineer. While such investigators as Beauchamp Tower, Osborne Reynolds, Sir John Dewrance, Summerfeld, Michell, and Kingsbury have done a great deal to advance the knowledge of the subject, there is much to be learnt regarding the size, lining, and clearances of bearings, and the properties and working conditions of the lubricants, to which attention was directed in an important paper on "Journal Bearing Practice", by Mr. F. Hodgkinson, read to the Institution of Mechanical Engineers on Nov. 15. The paper and a summary of the discussion which followed is given in both *Engineering* and the *Engineer* for Nov. 22. A few years ago, it was held that the relation which should govern the design of a high-speed bearing was that the pressure in pounds per sq. in., P, multiplied by the velocity of the rubbing surfaces in feet per second, V, should be 2500, but in modern practice, pressures run up to 150 pounds with velocities up to 150 feet. These figures are from steam turbines. It was also formerly considered that the bearing should be cool to the touch, but it was mentioned in the discussion that running the bearings of a certain 41,000 k.w. machine at 140° F. instead of 120° F. led to a saving of coal equal to £142 per annum. One interesting reference in this paper was that made to a gyroscopic stabiliser for a ship, the rotor of which weighed 230,000 lb. and ran at 800 r.p.m. The maximum bearing pressure in this case approximated to 900 lb. per sq. in. of projected surface.

Anniversary Meeting of the Royal Society.

THE anniversary meeting of the Royal Society was held on Nov. 30, and the presidential address delivered by Sir Ernest Rutherford. He referred to the loss by death during the past year of fourteen fellows of the Society and one fellow elected under Statute 12, which provides for the admission of persons who have rendered conspicuous service to science, or whose election would be of signal benefit to the Society. Mention was also made of the retirement of Sir David Prain and Sir James Jeans, treasurer and secretary respectively for the past ten years, during which period the number of pages annually in the *Proceedings* has grown from 700 to 3661, an increase in publication effort due mainly to the activity of Sir James Jeans. Sir Henry Lyons succeeds Sir David Prain as treasurer, and Lord Rayleigh becomes foreign secretary in succession to the former. Sir James Jeans is succeeded by Dr. F. E. Smith, well known for his work at the National Physical Laboratory on electrical standards, and until recently Director of the Scientific Research and Experiment Department at the Admiralty. He has recently been appointed Secretary to the Department of Scientific and Industrial Research, in connexion with which Sir Ernest remarked: "The Council feel that it is an advantage, rather than a disadvantage, that Dr. Smith should hold these two posts concurrently; for, although the main spheres of work of the two bodies are distinct, they have many interests in common in fostering the research activities of the nation".

The report of Council records a legacy, subject to a life interest, of £5000 free of duty, for general purposes, under the will of the late Prof. W. H. Perkin. A new research fellowship has been founded in accordance with the wishes of the late Mr. E. W. Smithson, who bequeathed to the Society a reversionary interest in the residue of his estate, now amounting to about £1200 a year. It has been decided to establish a fellowship at Cambridge for a period of four years in the first instance, and renewable annually up to a maximum of eight years in all, at an annual stipend of £800. The appointment is essentially for research, but permission will normally be given for the fellow to undertake a minimum of actual teaching in order to keep in touch with academic work. The award will usually be limited to British subjects.

Sir Ernest then discussed recent work in physics, referring in particular to the Raman effect and the constitution of hydrogen gas, and emphasising the close connexion between theory and experiment characteristic of modern progress; this appears elsewhere in this issue. The presentation of medals followed, and we print below extracts from the remarks made on the recipients' work.

Presentation of Medals.

COPLEY MEDAL, AWARDED TO PROF. MAX PLANCK.

In the first instance, Planck applied the concept of the quantum of action to derive a formula giving quantitatively the distribution of energy in the spectrum of a complete radiator at any temperature, and it was basing upon this that Einstein developed a formula for the atomic heats of solids as a function of the temperature, which laid the foundation for all progress that has been made on this subject in the last twenty years. The concept of quanta of action as applied by Bohr to atomic processes in 1913 has proved of fundamental importance in elucidating the meaning of the complicated spectral series, and it has given an insight into the constitution of the atoms and been able to account for their various properties from first principles. In its most recent developments, Heisenberg has shown that Planck's quanta of action are bound up with an essential indeterminacy of physical measurements, which has the most far-reaching metaphysical consequences. Though his name is not immediately associated with any of these theories, Planck has taken an important part in formulating, clarifying, and criticising these developments of his original idea. It is no exaggeration to say that the development of the idea of the quantum of action, first formulated by Planck nearly thirty years ago, has effected not only a veritable revolution in physics, but also profoundly changed our methods of thought and concepts of philosophy. Quite apart from his work on quanta, Planck's papers and books on other subjects are sufficient to place him in the front rank of physicists.

ROYAL MEDAL, AWARDED TO PROF. JOHN EDENSOR LITTLEWOOD.

The various problems which Prof. Littlewood has successfully attacked are characterised by their extreme difficulty. Into certain properties of primes, in which the Riemann zeta-function is employed, he has penetrated further than any other mathematician. Among the results he has obtained in this domain may be mentioned his proof that a conjectural expression given by Gauss for the number of primes less than a prescribed number is false, although its correctness is supported by all empirical evidence for numbers up to a thousand million. He has also obtained the best-known result giving the number of primes less than a prescribed number. In the general theory of series he has obtained various important results, the most celebrated of which is his Tauberian theorem for power-series. He has done much work on the general theory of functions, the earliest of which relates to integral functions of finite or zero order. His theorem that (roughly) a function of sufficiently low order has associated with it circles on which its minimum is of the same order as its maximum, has led the way to many developments by other mathematicians. Another striking piece of work is his extension to real sub-harmonic functions of the theorem due to Fatou, that an analytic function, bonded in the unit circle, tends to a limiting value almost everywhere on the unit circle. The importance and width of the results which have been published by the partnership of Prof. Hardy and Prof. Littlewood must also be referred to; among the subjects which they have treated are additive number theory, especially Waring and Goldbach problems, the theory of the zeta-function, Diophantine approximation, general theory of series, and Fourier's series.

ROYAL MEDAL, AWARDED TO PROF. ROBERT MUIR.

Prof. Muir is particularly distinguished for his pioneer work in the study of immunity reactions and mechanisms at a time when the foundations of the science of immunology were being laid, and the combining properties of normal and immune sera with antigen were being submitted to analysis by test-tube methods. Hæmolytic systems were chiefly studied and problems concerned with the specificity, constitution, and dissociation of immune bodies and with the combining properties of complements were attacked by accurate quantitative methods. These studies by Muir and his collaborators are of fundamental importance in the history of the development of the science. Muir's interests, however, have not

been confined to immunology. In the field of general and experimental pathology he has made important contributions to knowledge, and his researches on experimental anæmia produced by the injection of hæmolytic serum, and on the regenerative changes in the bone marrow in response to infection, are widely known.

DAVY MEDAL, AWARDED TO PROF. GILBERT NEWTON LEWIS.

Prof. Lewis, of the University of California, is justly regarded as one of the leaders of modern physical chemistry, mainly on account of his remarkable contributions to chemical thermodynamics. He has been responsible for the development of fresh and original methods in attacking the problem of chemical affinity. By the skilful utilisation of appropriate experimental measurements, Lewis and his collaborators have shown how the free energy of a great variety of elements and compounds can be ascertained, and how this quantity is related to the thermal and electro-chemical characteristics of chemical reactions in which these elements and compounds are involved. It is to Lewis that we owe the concepts of 'activity' and 'activity coefficient', and recent advances, more especially in our knowledge of the thermodynamic properties of solutions, are the direct outcome of the introduction and development of these ideas. Further, in the closely related field of electrode potentials, his work, both on the theoretical and practical sides, has been outstanding. Lewis has rendered great service to chemistry by his theoretical work on electron configuration, and the bearing of this on polarity, valency, and cognate matters. His conceptions in this field and his recognition of the fundamental importance of the electron duplet have greatly influenced the development of modern chemical theory.

HUGHES MEDAL, AWARDED TO PROF. HANS GEIGER.

Prof. Geiger, of the University of Tübingen, has made many important contributions to our knowledge of radioactivity. He was the first to examine in detail the scattering of α-particles by matter. His classical investigation, in collaboration with E. Marsden, on the large angle scattering of α-particles in their passage through matter, not only gave a definite experimental foundation to the nuclear theory of the atom, but also led to the suggestion that the properties of an atom are defined by its atomic or ordinal number—a suggestion strikingly verified by the investigations of Moseley. Among many notable researches in radioactivity, special reference may be made to his determination of the ranges of the α-particles from all the radioactive elements with the greatest possible precision. From these measurements we are enabled to deduce the velocity of expulsion of the α-particle from many radioactive bodies. He discovered with Nuttall a remarkable relation between the life of a radioactive element and the velocity of the α-particle ejected from it. This relation, known as the Geiger-Nuttall law, has an intimate bearing on the new theories of the constitution of atomic nuclei. With Sir Ernest Rutherford, Geiger devised an electric method of counting α-particles and determined the number of α-particles emitted by a gram of radium. Later Geiger devised a point detector of great sensibility, which could be used for counting both α-particles and β-particles. Within the last few years he has succeeded in making a new type of detector, by which the liberation of any electron throughout a comparatively large volume is detected. This beautiful device, which has been applied by Geiger himself and by others to the study of the penetrating radiation in the atmosphere, promises to provide a method of great power for extending our knowledge of this radiation.

Forestry in Kenya Colony.[1]

THE Annual Report of the Forest Department in Kenya Colony (to Dec. 31, 1928) directs attention to a fact which is well known in forestry economics, that any serious set-back to the country as a whole, whether due to climate, invasions of pests, disease or other troubles, will at once react on the forest sales and revenue. During the year here reviewed, the rains were everywhere much below the average, and a very serious infestation of locusts affected all parts of the country. The inevitable consequences followed, as stated in the report: "These two factors brought about a considerable restriction in trade and development of the Colony, which seriously affected the sales of timber and the partial drought greatly handicapped the Department's planting schemes". A check came to the continuous rise in revenue shown since 1926, as also in the rate of planting. This check is, however, regarded as purely temporary.

In the 1926 report the Conservator alluded to the fact that, owing to a paucity of staff, it was impossible to judge of the Colony's forest position as they had no data upon which to compare the annual cut with the existing stock of mature timber in the forests. The reviewer of that report in NATURE fully agreed with its author that such a position of affairs was "the most unsatisfactory aspect of the forestry position". In spite of the still existing difficulties due to an inadequate staff, the past two years have witnessed a decided effort to deal with the large amount of work connected with surveys of the forests and also, it is understood, with that important matter of stock mapping, however roughly, the growing stock of the reserves which are subject to fellings.

To the public outside Kenya, the most interesting factor connected with the forestry of the Colony is the well-known so-called pencil cedar (*Juniperus procera*), in which the report shows there was a large export, namely, 39,551 cub. ft., as compared with 13,548 cub. ft. in the previous year.

"The outlook of this trade", says the Conservator, "appears to be bright, provided only carefully selected, accurately sawn, and thoroughly seasoned slats are shipped and the price is moderate. A process has been developed in England for rapid treatment of the slats which appears to be most successful in seasoning and at the same time slightly softening the wood. The process appears to be a valuable one, which should help the trade considerably. Provided, however, the slats are carefully selected and thoroughly air seasoned, *i.e.* scientifically stacked under properly regulated conditions of air and moisture for, say, twelve months, the wood appears to be entirely suitable for pencil manufacture without artificial treatment.

"It is said that the preparatory treatment of cedar substitutes has made such improvement recently that these substitutes now compare very favourably in quality with cedar. It is not believed that these woods can ever be given quite the unique properties of cedar, but there is no doubt that cedar slats will have to be very carefully produced and at a comparatively low price if they are to compete successfully."

[1] Colony and Protectorate of Kenya. Forest Department Annual Report, 1928. Pp. 32. (Nairobi: Forest Department, 1929.)

It is a relief to know that the Conservator is of opinion that there are very considerable quantities of pencil cedar in the Colony, but that the survey of these is still very incomplete. The existing sawmills with cedar concessions can supply any immediate demands, and it is hoped in the near future to have other areas ready for exploitation.

Mr. H. M. Gardner, who is now the permanent Conservator, and his officers may be congratulated on a report which shows real progress. He is evidently an optimist, for the following extract shows that he has been able to perceive some benefit to forestry in the Colony as a result of the past drought. He writes: "The one satisfactory result of the drought conditions prevailing during the year was the very great increase in the public interest in forestry. The preservation of the existing forests and the increase of tree planting both on public and private land have become matters of public discussion throughout the Colony, which can result in nothing but good."

Physics in Fuel Problems.

DR. C. H. LANDER, Director of Fuel Research, delivered one of the public lectures on physics in industry which are arranged by the Institute of Physics, on Nov. 27, taking as his subject "Physics in Relation to the Utilisation of Fuel". Apart from the great development of physical instruments for the control of fuel-using appliances, physics enters into the study of most problems of preparation, treatment, and utilisation of fuel.

The microscope has been effectively enlisted in the examination of coal, both for the study of thin sections by transmitted light, whereby the more resistant plant remains are made visible for identification, and for the investigation of polished surfaces by reflected light. X-ray photography as developed by Kemp has proved very useful in revealing the distribution, nature, and amount of ash in coal, information giving a ready guidance as to the prospects of 'washing' a coal to improve its worth. Again, by means of the X-ray spectrometer, graphite has been identified in cokes of different types, and it has been found possible to correlate the size of the graphite crystals with the reactivity of the cokes as determined by a chemical method used at the Fuel Research Station.

All processes of coal cleaning depend on utilising differences between the physical properties of the coal and the impurity to effect a separation. Difference in density, size, shape, friction, resiliency, and surface tension to water have all been used for this purpose. These applications were illustrated by description of the principles of the different methods of wet and dry cleaning.

Dr. Lander referred to the influence of the manner in which heat is applied on the process of carbonisation in retorts, and then turned to the physical principles of the utilisation of fuel. In order to reduce the size of the combustion chamber of furnaces fired by pulverised fuel, it has been considered advisable to create turbulence in the fire gases. Dr. Lander questioned whether uncontrolled turbulence will prove so satisfactory a solution as to obtain stable stream-line motion of air, and to induce the particles of fuel to move across the stream line in a controlled manner; this might perhaps be attained by giving a vortical motion to the air admitted at the perimeter of the chamber while the products are withdrawn axially. The fuel would be admitted at any convenient point or points, and the particles would be compelled to cross the stream lines in a stable manner.

The physics of the fuel fired furnace is complicated by the fact that it involves transfer of heat from moving gases. Unfortunately, the complications are such as to prevent the treatment of the problem by 'models', as in aerodynamical research. In such furnaces, in addition to the flow of combustion gases, heat interchange by conduction, forced and natural convection, and radiation are occurring. So complex are the conditions that reliance has usually to be placed on empirical formulæ of limited application, but progress is being made to place these on a more fundamental basis. H. J. H.

Undulant Fever in England and Wales.

UNDULANT fever was regarded thirty years ago as a sub-tropical disease almost confined to the Mediterranean coast-line and islands; hence the old name of Mediterranean or Malta fever applied to the disease. It has now been recognised in every continent, with the possible exception of Australia.

The causative micro-organism of undulant fever is a micrococcus (*M. melitensis*), first described by Bruce in 1886 (though some regard it as a bacillus), and is spread almost entirely by goats' milk. In 1897, Bang of Copenhagen described under the name *Bacillus abortus* a micro-organism causative of contagious abortion in cattle. Research during the last few years has directed attention to the close similarity between *M. melitensis* and *B. abortus*, and inasmuch as *B. abortus* is frequently present in cows' milk, the question has arisen whether this organism may not cause a form of undulant fever in man. As a result of close clinical and bacteriological study of cases of irregular fever occurring in Great Britain, on the Continent, and in America, it has been shown that man is occasionally infected with the contagious abortion organism with the production of a form of undulant fever.

An exhaustive report on the subject by Capt. Dalrymple-Champneys has been issued by the Ministry of Health ("Undulant Fever." *Reps. on Pub. Health and Med. Subjects*, No. 56. London: H.M. Stationery Office. 1*s.* 6*d.* net), and it is found that at least 14 authentic cases of undulant fever in man caused by the *abortus* variety of the organism have originated in England. Many cases have been described in Denmark, some in Germany, and a number in America (366 cases this year, according to a *Daily Science News Bull.* issued by Science Service, Washington, D.C.). Contagious abortion is also widespread among animals other than the cow, namely, the sheep, pig, goat, horse, and dog, the causative organisms being of the *abortus* type, but sometimes presenting minute differences, so that several varieties exist.

Dr. Forest Huddleson has published a valuable contribution on the differentiation of these varieties, or species as he prefers to call them (*Technical Bull.*, No. 100, 1929. Agricultural Experiment Station, Michigan State College). The organisms are placed in a genus *Brucella*, which is divided into three main species, namely, *Br. abortus* (Bang), *Br. suis* (Traum),

and *Br. melitensis* (Bruce), as they show distinct differences from one another. Some 6-9 per cent of samples of English milk contain *Br. abortus*, yet undulant fever from this source is a rarity. The explanation of this apparent anomaly may be that this organism is of low virulence for man. Thus, it is difficult to infect monkeys with *Br. abortus*, whereas both *Br. melitensis* and *suis* are highly infective for this animal. The Americans are, therefore, disposed to attach more importance to the porcine than to the cattle strain of *Brucella* as a source of undulant fever in man derived from animals other than the goat.

University and Educational Intelligence.

CAMBRIDGE.—The Vice-Chancellor has announced that he has appointed Prof. Hermann Weyl, professor of higher mathematics in the Technical High School, Zurich, to be lecturer on Mr. Rouse Ball's foundation for the present academical year.

EDINBURGH.—At the meeting of the University Court on Monday, Nov. 25, on the recommendation of the Senatus, Dr. J. E. Mackenzie, reader in chemistry, was appointed to membership of the Senatus, and Dr. C. H. O'Donoghue, lecturer in zoology, was appointed reader with a seat on the Faculty of Science.

MANCHESTER.—The following honorary research fellows have been appointed: Dr. W. L. Dulière (Louvain), in physiology; Mrs. Wright Baker (Manchester), in botany; Miss Isabel Cookson (Melbourne), in botany; Dr. Stephen Náray-Szabó (Budapest), in physics; Prof. Linus Pauling (Pasadena, California), in physics; Mr. Joseph West (Manchester), in physics.

Mr. Harold Walkden has been elected to a Research Studentship in Botany.

AT the annual meeting of the court of governors of the London School of Hygiene and Tropical Medicine, held on Nov. 27, the board of management of the School presented its fifth annual report. In the year under review, ended July 31, 1929, the new home of the School, its equipment, and the development of its organisation advanced steadily towards completion, and on July 18 the Prince of Wales formally opened the new building. Special reference is made in the report to the new course of study designed to prepare candidates for the examination for the diplomas in public health, and especially the new academic diploma instituted this year by the University of London. This course is planned in a broad, practical spirit, and gives promise of a great advance on anything which has hitherto been systematically attempted with regard to public health teaching. Two large centres of public health administration have been secured as demonstration areas, an advisory committee of experts of the first standing in the public health service appointed, and a scheme of special lectures arranged. The courses of study in tropical medicine and hygiene are maintained at a high level, and include a special short course in hygiene for business or professional men and women proceeding to the tropics. The University Grants Committee has intimated that the Treasury has sanctioned a recurrent grant-in-aid at the rate of £40,000 a year, but impresses upon the School the necessity for taking all possible steps to secure an increased private income from the Colonies, from public or private subscriptions, and in other ways.

Calendar of Patent Records.

December 8, 1823.—The waterproofing industry dates from the patent granted to Charles MacIntosh for his "process and manufacture whereby the texture of hemp, flax, wool, cotton, and silk, and also leather, paper, and other substances, may be rendered impervious to water and air", the specification of which was enrolled on Dec. 8, 1823. The process, which consisted in placing a sheet of rubber (formed by dissolving small pieces of rubber in naphtha and allowing the solvent to evaporate) between two layers of fabric, was very successful, and MacIntosh's goods quickly attained a high reputation.

December 9, 1815.—The original gas-meter of Samuel Clegg was patented on Dec. 9, 1815. The apparatus consisted of a rotating wheel with a hollow rim connected by hollow arms with inlet and outlet passages for the gas in the axle, and provided with a water seal which closed the inlet and opened the outlet at the proper moment so that the number of revolutions of the wheel was a measure of the quantity of gas passing through. It was greatly improved later, but did not become commercially successful until towards the end of the patent term. The validity of the patent was established in the courts in an action for infringement.

December 10, 1779.—James Keir, F.R.S., doctor, soldier, manufacturer, and chemist, was granted a patent on Dec. 10, 1779, for "a compound metal capable of being forged, more fit for the making of bolts, nails, and sheathing for ships than any metal heretofore used for those purposes". The new alloy—which contained 54 per cent copper, 40·5 per cent zinc, and 5·5 per cent iron—was brought to the attention of the Admiralty by Mathew Boulton (who called himself the joint inventor), and a ship—the *Juno* frigate—was placed at Keir's disposal for a trial. The requisite number of plates and bolts were made, but there is no further record of the experiment. Keir's metal does not appear to have been referred to in the litigation on the Muntz metal patent sixty or so years later.

December 10, 1782.—The "new invented method of making small shot solid throughout and perfectly globular in form" by pouring the melted metal from a height into water was patented by William Watts, a plumber of Bristol, on Dec. 10, 1782. The process was adopted with success and was in general use by the end of the century.

December 10, 1845.—The first pneumatic tyre was patented by Robert William Thomson on Dec. 10, 1845, and consisted of a hollow belt composed of several thicknesses of canvas saturated with rubber solution and cemented together, the whole being then vulcanised. The cover was of leather. A set of the tyres is said to have run for 1200 miles without deterioration. Dunlop's patent, on which the present industry is based, was not granted until 43 years later.

December 11, 1863.—The ammonia-soda method of making sodium carbonate was made commercially successful by the process invented by Ernest Solvay and patented by him in Great Britain on Dec. 11, 1863. A factory was opened at Charleroi in 1865, and the industry quickly became established and finally ousted the Leblanc process. Brunner, Mond and Co., at their works at Northwick, were the first in England to adopt the new process.

December 12, 1885.—The incandescent gas mantle was patented in Great Britain by the late Karl Auer von Welsbach of Vienna, the inventor, on Dec. 12, 1885. The first mantle to reach England was brought over in a bird-cage by a woman, who refused to let the cage go out of her hands during the journey.

Societies and Academies.

LONDON.

Mineralogical Society, Nov. 6.—**C. E. Tilley**: On scawtite, a new mineral from Scawt Hill, Co. Antrim (with chemical analysis by Mr. M. H. Hey). This new monoclinic mineral, with composition $6CaO \cdot 4SiO_2 \cdot 3CO_2$, occurs in the contact zone between the chalk and tertiary dolerite, from which another new mineral, larnite, was recently described (*Min. Mag.*, vol. 22, p. 77).—**F. Coles Phillips**: On the composition-plane of [010]-twins in the acid plagioclases. In the true pericline twin, the inclination of the variable composition-plane for different composition is correctly given by Wulfing's curve. T. Barth's conclusion that there is no regular variation is not justifiable, and results partly from confusion with other twin-laws such as that of acline *A*. The pericline twin should be of frequent occurrence in the crystalline schists.—**M. H. Hey**: On the variation of optical properties with chemical composition in the rhodonite-bustamite series. A complete optical study of three analysed members of the rhodonite-bustamite series, with the data available from the literature, shows regular variation in the optical properties and specific gravity with change in lime content.—**F. Coles Phillips**: A preliminary account of some mineralogical and chemical changes induced by progressive metamorphism in the Green Bed group of the Scottish Dalradian. Analyses prove the Green Beds to be a truly isochemical series in respect of the constituents significant in progressive metamorphism. The earliest-formed plagioclase is pure albite, but a progressive entry of the anorthite molecule can be traced. The adjustment to equilibrium is apparently close, all the reconstituted plagioclase of a given rock having the same composition. In the highest grades the felspar is a medium andesine. Similar variations with increasing grade are found in the associated epidiorites. The earliest-formed greenish micaceous mineral is a true potash mica, which undergoes increase in FeO in higher grades. Hornblende appears in the chlorite-zone only in rocks low in potash.

Optical Society, Nov. 14.—**A. G. Frewin**: (1) The Busch optometer (eye refractor) designed by Prof. Thorner; (2) A glare-free, reflexless, stereoscopic hand ophthalmoscope. The new ophthalmoscope has a concave mirror which focuses a source of light on the lower part of the patient's dilated pupil. The optical system is such that the two pupils of the observer are conjugate with two separated points just above the image of the light. The action is thus similar to that of a policeman peering through a small window-pane into a dark room which he illuminates with his bull's-eye.

PARIS.

Academy of Sciences, Oct. 28.—**A. Cotton**: The problem of asymmetric synthesis and the combined actions of polarised light and of a magnetic field on certain photographic plates.—**Georges Claude**: The first attempts to realise at Cuba a Claude-Boucherot apparatus. An account, with photographs, of the first unsuccessful attempt to launch a tube, 2 metres in diameter and 2 kilometres long, in the bay of Matanzas, Cuba.—**Pierre Weiss** and **R. Forrer**: The magnetisation to saturation of ferrocobalts and the atomic moments of iron and of cobalt. The magnetisation to saturation of 25 cobalt-iron alloys, ranging from 0 to 100 per cent cobalt, is described. The results are given graphically.—**J. Herbrand**: The limited solutions of certain functional equations.—**P. Dubreil**: Some complements to the theory of Nœther.—**J. A. Lappo-Danilevski**: The explicit expressions of the invariants of a monodrome group of a system of linear differential equations with arbitrary rational coefficients.—**N. André Roussel**: The generalised primitive of a function.—**Victor Vâlcovici**: The generalisation of the theorem of energy.—**Joseph Pérès**: Concerning the fundamental problem of the theory of vortices.—**William Loth**: Remarks on the guiding of ships or aeroplanes by directed waves.—**L. Décombe**: The mechanism of emission and Melde's experiment.—**Paul Jayles**: The electrolytic chlorination of benzene in methyl alcohol solution. Electrolysis without a diaphragm gave monochlorbenzene as the main product with a small proportion of benzene hexachloride. The same products were obtained in higher yields using a diaphragm.—**M. Laporte** and **La. Goldstein**: Activation in the rare gases.—**A. Gillet** and **D. Guirchfeld**: The existence of a chemical equilibrium in autoxidation. In the direct oxidation by oxygen gas, in air, experiments are described in support of the view that there exists for each temperature an equilibrium pressure of oxygen below which no fixation of oxygen upon the autoxidisable body takes place.—**René Dubrisay** and **Albert Saint-Maxen**: The autoxidation of hydroquinone. Measurements giving the rate of oxidation of solutions of hydroquinone as a function of *p*H.—**Mme Ramart-Lucas** and **J. Hoch**: The comparative stability of the ethylenic stereoisomers and syntheses by ultra-violet rays.—**Gaston Rapin**: The action of some dioxides on very dilute aqueous solutions of potassium permanganate.—**L. Palfray** and **B. Rothstein**: The halogen derivatives of 1·4 cyclohexanediol (quinite). These can be obtained by the interaction of quinite and halogen acid.—**A. Pereira Forjas**: The spectrochemistry of Portuguese mineral waters. The water of Cambres. In addition to the ions detected by ordinary chemical methods, the spectroscope revealed the presence of radium, lead, uranium, vanadium, zinc, copper, germanium, and possibly thallium.—**Daniel Chalonge** and **F. W. Paul Götz**: Diurnal and nocturnal measurements of the quantity of ozone contained in the upper atmosphere. Measurements made at Paris and at Arosa by the spectrographic method, showed that at these places the presence or absence of the sun caused no notable change in the thickness of the ozone layer.—**A. Guillaume**: The alkaloid losses in the course of drying plants under varied conditions.—**Jules Amar**: The hemopneic coefficient and its applications.—**F. Obaton**: The relation between the nature of the glucides of *Sterigmatocystis nigra* and that of the sugars supplied to it. There is a correlation between the nature of the product made by the *Sterigmatocystis* and the sugar supplied as food to the mycelium. This relation is more marked between glucose and trehalose than between lævulose and mannitol.—**H. Pénau** and **G. Tanret**: The mercury reducing power of normal urine. The mercury reducing figure, although admittedly arbitrary, furnishes data which may be of service in the examination of urine.—**R. Fosse**, **A. Brunel**, and **P. de Græve**: Allantoinase and the origin of allantoic acid in plants.—**G. Ramon**: The production of a very active diphtheric toxin. The usual method of preparation is modified by the addition of a certain proportion of glucose. A toxin of high activity is obtained.

ADELAIDE.

Royal Society of South Australia, Oct. 10.—**Thomas T. Colquhoun**: Polarity in *Casuarina paludosa*. Portions of bark of a young tree were removed, turned end for end and regrafted. The resultant shoots were tested for growth of roots unsuccessfully. The grafts

were removed and sectioned, the junction between the normal wood and inverted wood being marked by abnormal twisting of the trachæ and trachieds, suggesting that translocation effects required the same orientation of the conducting strands.—**J. G. Woods**: Floristics and ecology of the mallee. The mallee is a transition region between the savannah forests of the southern wetter districts and the Eremian or northern communities of saltbush and mulga. The geographical range of the chief tree species (*Eucalyptus spp.*) is sharply limited by the 20-inch isohyet in the south and the 8-inch isohyet in the north. In New South Wales its northern limit is determined by the northern limit of winter rains. The soils are all alkaline (*p*H about 8·0) and all contain nodular travertine limestone. Analysis of the growth forms gives a spectrum showing preponderance of woody shrubs and undershrubs of pronounced sclerophyll type and with a large therophytic element. Of the total number of species only about 25 per cent are confined to the mallee; the rest are migrants from the northern and southern communities.—**Albert H. Elston**: Australian Coleoptera (Part 6). Names and describes three new species of Elateridæ and one new genus and seven new species of Cleridæ.

Cape Town.

Royal Society of South Africa, Sept. 25.—**J. C. Vogel**: The cause of the Russell effect observed in oils. On exposing moist starch potassium iodide paper near oils of animal, vegetable, and mineral origin, iodine stains develop. The intensities of the stains produced by different oils are proportional to the intensities with which they act on photographic plates exposed near them (Russell effect). The reaction only takes place in the presence of oxygen. The liberation of iodine is due to the liberation of volatile oxidation products consisting of normal fatty acids containing four or more carbon atoms. The Russell effect and the supposed photoactivity of oils is due to the reducing properties of the vapours of these acids.—**H. Spencer Jones**: The secular variations of the orbital elements of the inner planets. Recent determinations of the change in the obliquity of the ecliptic indicate an appreciable correction to Newcomb's value, which can be accounted for by an error in his adopted mass of Venus. If the revised mass of Venus is adopted, the mass of the earth deduced from the secular variations of the orbital elements corresponds to a still smaller value of the solar parallax. The discordance can be traced to the motion of the node of Venus upon which the mass of the earth obtained from the secular variations almost entirely depends. With the most probable system of masses, the discordance between the observed and theoretical motions is six times the probable error. The motion of the node of Venus is the only remaining outstanding discordance between theory and observation in the planetary elements.—**B. de St. J. van der Riet** and **G. W. B. van der Lingen**: The wax of the rhenoster bush (*Elytropappus Rhenocerotes*). The air-dry tips of Rhenoster bush collected at Stellenbosch were found to yield on extraction with volatile organic solvents up to about 10 per cent of wax-like material. The yield and nature of the 'wax' varied according to the solvent used for extraction.—**F. C. Cawston**: The problem of the ventilation of iron roofs in the tropics. The present system of ventilating iron roofs is very inadequate and a cowl on the summit is insufficient unless there is a corresponding provision of air inlet. This inlet should be provided by means of a ventilating shaft inserted on a slant at each corner of the roof to supplement adventitious draughts.

Leningrad.

Academie des Sciences (*Comptes rendus*, No. 16).—**W. Willams**: Action of nitric acid on dihydroperillamine. Cyclical primary amines of the terpene series with the NH_2 group in the side chain are able, like the polymethylene primary amines, under the influence of nitric acid, to isomerise with the increase in the cycle by one atom of carbon.—**V. Feofilaktov**: The condensation of pyruvic acid with formaldehyde in the presence of sulphuric acid. The usual idea, that the product of the condensation is a tetramethylene-1 : 3-dioxalic acid, namely, $C_8H_8O_6$, is erroneous; there are two products, and one of them, mistaken for $C_8H_8O_6$, has actually the formula $C_9H_8O_6$ and the structure of a methylene-bis-α-tetronic acid.—**B. Numerov** and **N. Samsonov**: Results of gravimetric observations made in 1928 near Lake Baskuntchak. A gravitational survey of the area revealed the presence of several anomalies which must depend on the geological strata, but the area surveyed was not sufficiently extensive.—**B. Numerov** and **B. Kozlovskij**: Results of gravimetric observations made in 1927–28 in the Emba area. Minimums of gravitational force in the area surveyed correspond to the places where more ancient strata, namely, Permotriassic, come near the surface, while the oil-bearing strata are somewhat removed from them. The greatest negative anomaly indicates the presence of salt-bearing strata.—**N. Nasonov**: Notes on *Phlebotomus* (3). A gradual increase in the numbers of sand-flies in the Crimea which has been observed during the last fifty years is due to the gradual progressive desiccation of the peninsula caused by the deforestation of the Yaila mountains.—**P. Schmidt**: The subfamily Blepsiinæ (Pisces, Cottidæ) in the Pacific. The following forms occur in the North Pacific: *Blepsias cirrhosus* Pall., *B. cirrhosus* sbsp. *draciscus* Jord. and Starks; *B. bilobius* C.V. (= *Histiocottus bilobus* C.V.); *Nautichthys oculofasciatus* Gir. (= *Nautiscus pribilovius* Jord. and Gilbert).

Prague.

Czech (Bohemian) Academy of Sciences and Arts (Second Class, Natural Sciences and Medicine), Oct. 18.—**Dr. Sedláčková**: Influence of choline on the glycoregulation of tissues.—**V. Vondráček**: Characterology from the medical viewpoint.—**A. Jílek** and **J. Lukas**: Electroanalytical determination of thallium as thallic oxide. The anodic deposit from solutions of thallous nitrate in presence of hydrofluoric acid and hydrogen peroxide consists practically of $Tl_2O_3 \cdot HF$; this may serve for quantitative estimation; in the presence of alkali salts the results are somewhat higher.—**K. Kavina**: Virescence of flowers of *Anthriscus cerefolium* Hoffm. subspec. *trichospermus* Schult.—**R. Šimůnek**: The resistance of electrolytes to high frequency oscillating currents. In an oscillating circuit the presence of electrolyte increases its high frequency resistance. It was measured at wavelengths of 600, 300, 150 metres and compared with the value calculated from J. J. Thomson's formula; the agreement was satisfactory. The method is electrodeless.—**K. Koutský**: The quadratic character of numbers and the generalisation of a certain Lagrange rule of the partition of quadratic residues.—**J. Rasch**: Influence of fatty acids on the maximum of current due to atmospheric oxygen in electrolysis with the dropping mercury cathode. The maximum is greatest when the ionic concentration is *ca.* $0{\cdot}5 \times 10^{-3}n$, as in solutions of strong electrolytes. Undissociated molecules have the greater effect in suppressing the maximum the higher the acid; anions of lower acids are indifferent like those of strong electrolytes; palmitate and stearate molecules and ions

have great suppressor activity, due to their abnormally great adsorbability. From the suppressor action a measure for the adsorbability of the acids in the mercury-solution interface is derived.—**Milovidov**: Influence of radium rays on the chondriosome of vegetable cells.—**K. Dusl**: Mathieu functions.—**E. Votoček** and **S. Malachta**: A new transition from sugars to the furane group. Transition of 5-keto-rhamno-lactone into the methyl ester of the methoxy-methyl-furane-carboxylic acid has been effected by methyl alcohol and hydrochloric acid.—**L. Borovanský-O. Hněvkovský**: Growth of the body and the progression of ossification in boys from birth up to nineteen years of age.

Nov. 8.—**O. Tomíček** and **A. Jánský**: Determination of halogenides in presence of sulphites. In solutions of the normal sulphites only the iodide can be exactly estimated; in the presence of bisulphites the bromide is also exactly determinable; in fairly acidic solutions all the three halides are determinable. —**O. Tomíček** and **A. Jánský**: The determination of iodides and bromides in chlorides. Traces of iodide can be estimated directly by silver even in solutions containing 1 mgm. I′ per litre of a 10 per cent NaCl solution. Winkler's apparatus and method for the isolation of bromides from chlorides has been improved.—**A. Orlov**: Wavellite from Černovice near Tábor (in south Bohemia).—**B. Hostinsky**: The probability of phenomena joined into Marek's chains. —**K. Žlábek**: Dependence of the form of musculus digastricus mandibulæ of man and anthropoid apes on the mechanism of the jaw-bone joint.—**B. Hejda** and **A. Vančura**: Urogenetic coefficients in liver diseases.

SYDNEY.

Royal Society of New South Wales, Oct. 2.—**J. A. Cresswick** and **S. W. E. Parsons**: The testing of lead azide detonators. The ballistic pendulum was used so that a direct reading might be obtained of each shot fired. As a preliminary, charges of 10 grams each of standard non-gelatinous powders were fired, using alternatively the aluminium and copper type detonators. The same explosives were then desensitised with liquid paraffin, to determine the point at which one type of detonator would fire the charge whilst the other type failed. After a lapse of two months the mixtures were again tested, using aluminium detonators, and in each case complete detonation of the charge resulted, with same development of power as when previously made. The results prove that aluminium (lead azide) detonators, as at present imported into Australia, are slightly more efficient as initiating agents than the older copper (mercury fulminate) type of the same number.—**J. C. Earl**: The action of acids on diazoaminobenzene. Diazoaminobenzene, when acted upon by acids, yields, according to the conditions, aminoazobenzene or phenyl diazonium salts and aniline. The detection of an intermediate product is described, with experiments showing the profound effect of very small quantities of acids on diazoaminobenzene. The employment of carbon dioxide to liberate the nitrous acid required for the preparation of diazoaminobenzene is advised.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, vol. 15, No. 9, Sept. 15).—**Elery R. Becker, J. A. Schulz**, and **M. A. Emmerson**: A comparative study of the digestion of proteins and carbohydrates in goats during infusoria-free and -infected periods. Infusorian infection gives no significant advantage.—**Benjamin Kropp**: The melanophore activator of the eye. An investigation by blood-transfusion methods of the hypothesis that the blood carries an activator. Extracts of eyes of dark-adapted *Rana clamitans* tadpoles injected into the abdominal cavity of light-adapted tadpoles induced melanophore expansion. Probable source of the activator is the retina.—**F. Simon** and **E. Vohsen**: Note on Mr. King's paper: "The crystal structure of strontium".—**Roscoe G. Dickinson** and **Robert T. Dillon**: The Raman spectrum of gypsum. Comparison of the spectrum with that of an aqueous solution of ammonium sulphate.—**Robert T. Dillon** and **Roscoe G. Dickinson**: Raman spectra from acetone. Results do not agree with those obtained by Williams and Hollaender.—**F. O. Rice** and **R. E. Vollrath**: The thermal decomposition of acetone in the gaseous state. Pure dry nitrogen saturated with acetone was passed at a known rate through a quartz tube in an electric furnace at 630° C. About 60 per cent of the acetone decomposed is recovered as ketene ($CH_2 : CO$). This result is not in accord with investigations in which rate of change of pressure is measured.—**Donald Statler Villars**: The equilibrium constants of reactions involving hydroxyl.—**Linus Pauling**: On the crystal structure of the chlorides of certain bivalent elements. Using results published by Bruni and Ferrari from powder data, it is deduced that cadmium and other divalent chlorides have a structure in which each cation is surrounded by six chloride ions approximately at the corners of a regular octahedron, six edges of which are shared with other octahedra so as to form a layer.—**L. H. Adams** and **R. E. Gibson**: The elastic properties of certain basic rocks and of their constituent minerals. Compressibilities, at pressures between 2000 and 12,000 megabaryes (1 megabarye = about 1 atmosphere) were measured by submitting specimens to hydrostatic pressure in a steel cylinder and determining decrease in volume. For basic rocks, it seems that compressibility calculated from mineral content gives a limit to which that of rocks approaches at high pressure. The maximum velocity of longitudinal waves through such rocks at 15,000 megabaryes and 30° C. is 7·4 km. a second. Garnet and jadeite have low compressibilities, indicating that eclogites transmit such waves at greater velocities.—**A. Oppenheim**: The minima of indefinite quaternary quadratic forms.—**G. A. Miller**: On the number of cyclic subgroups of a group.—**Henry P. Thielman**: On new integral addition theorems for Bessel functions. —**George D. Snell**: Dwarf, a new Mendelian recessive character of the house mouse. Mature individuals are about one-quarter the size of normal adults, are fairly healthy though subnormally active, and apparently sterile.—**Sophia Satina** and **A. F. Blakeslee**: Criteria of male and female in bread moulds (Mucors). There is no constant vegetative difference between gametangia of dicœcious species, and an attempt to differentiate between them by imperfect sexual reactions failed.—**H. W. Leavitt, J. W. Gowen**, and **L. C. Jenness**: (1) Influence of aluminium on mortar strength. As aluminium content of sand increases from 0·25 per cent to 3·75 per cent, the tensile strength of mortar increases by more than 100 pounds; compression strength is not affected. (2) On the joint influence of iron and aluminium in native sands on mortar strength. The total correlation coefficient is +0·538. An equation is deduced: Mortar strength = 20 aluminium (per cent) + 43 iron (per cent) + 272. There must be chemical interaction between sand and cement.—**Roy J. Kennedy**: Planetary motion in a retarded Newtonian potential field. The idea corresponding to that of effective charge developed by Lienard and Wiechert in electro-magnetism is applied to gravitation.—**J. H. Van Vleck**: On the vibrational selection principles in the Raman effect.

Official Publications Received.

BRITISH.

Proceedings of the Cambridge Philosophical Society. Vol. 25, Part 4. Pp. 369-540. (Cambridge: At the University Press). 7*s.* 6*d.* net.

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 67, No. 395, November. Pp. 1269-1336+xxxviii. (London: E. and F. N. Spon, Ltd.) 10*s.* 6*d.*

Ministry of Health. Treatment of Tuberculosis: Costs at Residential Institutions. (Memo. 122 C/T.) Pp. 21. (London: Ministry of Health.)

Tanganyika Territory. Tsetse Research Annual Report for the Year ended 31st March 1929. Pp. 18. 2*s.* 6*d.* Tsetse Reclamation Annual Report for the Year ended 31st March 1929. Pp. 10. 1*s.* 6*d.* (Dar es Salaam: Government Printer.)

Department of Agriculture, Ceylon. Bulletin No. 86: The Control of "Calotermes" in Living Plants. By F. P. Jepson. Pp. 11. 40 cents. Leaflet No. 57: Green Manuring with particular reference to Coconuts. Pp. 10. 5 cents. (Peradeniya.)

FOREIGN.

Department of the Interior: U.S. Geological Survey. Bulletin 799: Geology of the McCalls Ferry-Quarryville District, Pennsylvania. By Eleanora Bliss Knopf and Anna I. Jonas. Pp. xiii+156+8 plates. 35 cents. Bulletin 808: Geology of the De Queen and Caddo Gap Quadrangles, Arkansas. By Hugh D. Miser and A. H. Purdue. Pp. xi+195+18 plates. 75 cents. Bulletin 809: Formulas and Tables for the Construction of Polyconic Projections. Compiled by C. H. Birdseye. Pp. v+126. 25 cents. Bulletin 810-C: The Mount Spurr Region, Alaska. By Stephen R. Capps. (Mineral Resources of Alaska, 1927-C.) Pp. ii+141-172+plates 3-4. Bulletin 811-B: Recent Mining Developments in the Creede District, Colorado. By Esper S. Larsen. (Contributions to Economic Geology, 1929, Part 1.) Pp. ii+89-112+plate 26. 10 cents. (Washington, D.C.: Government Printing Office.)

Department of the Interior: U.S. Geological Survey. Water-Supply Paper 599: Ground Water in Yellowstone and Treasure Counties, Montana. By George M. Hall and C. S. Howard. Pp. vi+118+7 plates. 25 cents. Water-Supply Paper 600: Geology and Ground-Water Resources of Central and Southern Rosebud County, Montana. By B. Coleman Renick; with Chemical Analyses of the Waters, by H. B. Riffenburg. Pp. x+140+12 plates. (Washington, D.C.: Government Printing Office.) 35 cents.

CATALOGUES.

The Nickel Bulletin. Vol. 2, No. 5, November. Pp. 129-176. (London: The Mond Nickel Co., Ltd.)

Books Beautiful. Pp. 32. (London: George G. Harrap and Co., Ltd.)

Annotated and Classified Catalogue of Works on Mathematics, Astronomy and Physics, with an Appendix of Rare and Valuable Books, including the Newton Library. (No. 816.) Pp. 160. (London: Henry Sotheran, Ltd.)

Diary of Societies.

FRIDAY, DECEMBER 6.

INSTITUTION OF WATER ENGINEERS (at Institution of Civil Engineers), at 10.30 A.M.—R. C. S. Walters: The Hydro-geology of the Chalk of England.—Prof. E. Morton: Some Problems in Hydro-geology.—Discussions on Reports of the Advisory Committee on Water of the Ministry of Health; Second Report of the Legislation Sub-Committee; Report on Rural Water Supplies; Draft Report of a Sub-Committee of the Council on Stream Flow and Underground Water Records.

ROYAL SOCIETY OF MEDICINE (Otology Section), at 10.30 A.M.

ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 5.

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (at Liverpool University), at 6.—J. P. Davidson: The Manufacture of Tobacco.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Newcastle-upon-Tyne), at 6.—Prof. Dempster Smith: Cutting Capabilities of Lathe Tools.

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (jointly with Manchester Section of Institution of Rubber Industry) (at Engineers' Club, Manchester), at 7.—H. C. Young: The Common Factors of Technical and Works Controls in the Rubber and Chemical Industries.

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7.—Dr. C. V. Drysdale: Alternating-Current Potentiometers and their Applications.

INSTITUTION OF LOCOMOTIVE ENGINEERS, LONDON (at Manchester Literary and Philosophical Society, Manchester), at 7.—J. W. C. Armstrong: Pulverised Fuel Locomotives.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—W. A. Tookey and others: Diesel Engine Developments.

BRITISH NON-FERROUS RESEARCH ASSOCIATION (at Chamber of Commerce, Birmingham), at 7.—D. M. Smith: Spectroscopic Analysis of Metals.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—H. Bairstow and others: Discussion on How can the Pictorial Group best help the would-be Pictorialist?

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—A. B. Gowring: The Demolition of Lambeth Bridge.

GEOLOGISTS' ASSOCIATION (at University College), at 7.30.—J. A. Steers: The Great Barrier Reefs and the Queensland Coast: a Geographical Reconnaissance (Lecture).

ROYAL SOCIETY OF MEDICINE (Anæsthetics Section), at 8.30.—Discussion on Anæsthesia in Rectal Surgery.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Hugh Walpole: The Novel and the Creative Spirit.

SATURDAY, DECEMBER 7.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South-Western District) (at Exeter), at 3.—Lieut.-Col. E. J. Stead: The Local Government Act, 1929.

GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W.C.1) at 3.—W. H. Spreadbury: Some Birds of London's Country.

MINING INSTITUTE OF SCOTLAND (at Royal Technical College, Glasgow), at 3.—B. A. Peach: The Lochaber Water Power Scheme and its Geological Aspect.—Discussions on S. Mavor's paper on Recent Progress in Underground Conveying and J. E. Lambert's paper on Some Notes on Colliery Blasting Practice.

MONDAY, DECEMBER 9.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Armstrong College, Newcastle-upon-Tyne), at 7.—B. A. G. Churcher and A. J. King: The Analysis and Measurement of the Noise emitted by Machinery.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—W. R. Rawlings and T. C. Gilbert: Discussion on To Earth and not to Earth.

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (at Liverpool University), at 7.—Lt.-Col. S. E. Monkhouse and L. C. Grant: The Heating of Buildings Electrically by means of Thermal Storage.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members' and Graduates' Section) (at Borough Polytechnic), at 7.—B. A. Pountney: Common and Uncommon Boiler Troubles.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Scientific and Technical Group), at 7.—Prof. W. L. Bragg: X-ray Optics (Lecture).

BRADFORD TEXTILE SOCIETY (at Midland Hotel, Bradford), at 7.30.—Dr. S. G. Barker: Production of the Ideal Textile Fabric.

INSTITUTE OF METALS (Scottish Local Section) (at 39 Elmbank Crescent, Glasgow), at 7.30.—G. L. Cassidy: Melting Furnaces.

SURVEYORS' INSTITUTION, at 8.—W. E. A. Bull: The Landlord and Tenant Act 1927 in Operation.

TWICKENHAM LITERARY AND SCIENTIFIC SOCIETY (at Free Library, Twickenham), at 8.—C. A. Wood: Birds of Middlesex.

MEDICAL SOCIETY OF LONDON, at 8.30.—W. Trotter and others: Discussion on The Treatment of Head Injuries.

INSTITUTION OF ELECTRICAL ENGINEERS (Western Centre) (at Gloucester).

ROYAL IRISH ACADEMY (Dublin).

TUESDAY, DECEMBER 10.

ROYAL SOCIETY OF MEDICINE (Therapeutics and Pharmacology Section), at 5.—Dr. J. W. Trevan, Dr. T. Izod Bennett, Dr. D. T. Davies, Dr. L. E. H. Whitby, and others: Phenylhydrazine in the Treatment of Polycythæmia.—Dr. B. Schlesinger, Dr. F. J. Poynton, and others: Nirvanol in the Treatment of Chorea.

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.—J. Gillespie: The Engineer in Relation to the Petroleum Industry.

INSTITUTE OF MARINE ENGINEERS, at 6.30.—Vice-Admiral Sir Robert Dixon: Presidential Address.

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.—Lt.-Col. S. E. Monkhouse and L. C. Grant: The Heating of Buildings Electrically by means of Thermal Storage.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at Engineers' Club, Manchester), at 7.—Dr. G. C. Simpson: Lightning (Kelvin Lecture).

ILLUMINATING ENGINEERING SOCIETY (at Home Office Industrial Museum), at 7.—Discussion on Problems in Illuminating Engineering, opened by a series of short contributions on different subjects, including The Lighting of Large Vertical Surfaces, A. Cunnington; The Lighting of Operating Tables in Hospitals, E. Stroud; A Large Gas-Lighted Sign Outside Watson House, F. C. Smith; The Lighting of the Savoy Theatre and Hotel, Prof. H. Robertson and B. Ionides.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Colour Group), at 7.—Helen Messinger Murdoch: The World in its True Colours.

INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Centre) (at King's Head Hotel, Coventry), at 7.30.—Dr. B. P. Haigh: The Relative Safety of Mild and High-Tensile Steels under Alternating and Pulsating Stresses.

ELECTRICAL POWER ENGINEERS' ASSOCIATION (Edinburgh Section) (at North British Station Hotel, Edinburgh), at 7.30.—R. H. Rawll: The Electrical Equipment of Factories (Lecture).

INSTITUTE OF METALS (North-East Coast Local Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—W. T. Griffiths: Nickel in Non-ferrous Foundry Alloys.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—T. A. Joyce and E. L. Gruning: The Expedition of the British Museum to British Honduras, 1929.

ROYAL SOCIETY OF MEDICINE (Psychiatry and Disease in Children Sections), at 8.30.—Discussion on The Difficult Child.

PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, at 8.30.—Dr. S. S. Pickles: Rubber Manufacture (Lecture).

WEST KENT SCIENTIFIC SOCIETY (at Wesleyan Hall, Blackheath Village), at 8.30.

WEDNESDAY, DECEMBER 11.

ROYAL SOCIETY OF MEDICINE (Surgery: Sub-Section of Proctology), at 5.30.—C. Rowntree and others: Discussion on Complications of Operations for Piles.

INSTITUTION OF CIVIL ENGINEERS (Informal Meeting), at 6.—A. H. Barker: The Heating of Buildings by Electricity off Supply Mains, with Special Reference to the Problem of Heat-Storage and Off-Peak Loads.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Northern Ireland District) (at Municipal College of Technology, Belfast), at 6.45.—R. B. Donald: Town Planning.

SOCIETY OF CHEMICAL INDUSTRY (Newcastle-upon-Tyne Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.—L. H. Sensicle: Fuel Gas Technique—Some Modern Developments.

INSTITUTE OF CHEMISTRY (Edinburgh and East of Scotland Section) (jointly with Society of Chemical Industry: Edinburgh and East of Scotland Section) (at North British Station Hotel, Edinburgh), at 7.30.—J. A. Watson: The Industrial Minerals of Scotland.

ROYAL SOCIETY OF ARTS, at 8.—Major C. Wheeler: Overheads and other Factors influencing Road Transport Costs, from an Engineer's Viewpoint.

FARADAY SOCIETY (jointly with the Electroplaters' and Depositors' Technical Society) (at Northampton Polytechnic Institute), at 8.—B. Clark and E. O. Jones: The Effect of Addition Agents upon the Conductivity, Cathodic Polarisation, and Grain Size of Deposits obtained from the Cell: $Cu/CuSO_4$, H_2SO_4/Cu.—S. Glasstone and E. B. Sanigar: The Electro-Deposition of Silver from Argento-cyanide Solutions.

THURSDAY, DECEMBER 12.

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—W. N. Bailey: An Extension of Whipple's Theorem on Well-poised Hypergeometric Series.—Mary L. Cartwright: On the Maximum Modulus Principle for Functions with Zeros and Poles.—T. Estermann: On the Representation of a Number as the Sum of Two Products (Second Paper).—D. E. Littlewood: The Solution of Linear Congruences in Quaternions.—Prof. L. J. Mordell: On Hecke's Modular Functions and Some Other Analytic Functions in the Theory of Numbers.—L. Roth: Line Congruences in Three Dimensions.

CHEMICAL SOCIETY (at Institution of Mechanical Engineers), at 5.30.—Prof. H. Freundlich: Surface Forces and Chemical Equilibria (Liversidge Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS (jointly with British Section of Société des Ingénieurs Civils de France), at 6.—L. A. E. Sekutowicz and A. Evain: The Electrical Plant and Network of the Société Électrique de la Sidérurgie Lorraine.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—Dr. W. Rosenhain: The Development of Materials for Aircraft Purposes.

SOCIETY OF CHEMICAL INDUSTRY (Bristol Section) (jointly with Chemical Engineering Group) (at Bristol University), at 6.30.—S. Robson: The Treatment of Flotation Concentrates preparatory to Zinc Smelting.

INSTITUTE OF MARINE ENGINEERS, at 6.30.—J. R. Douglas: What is expected of a Junior Engineer on joining his First Ship?

INSTITUTE OF METALS (Birmingham Local Section) (at Chamber of Commerce, Birmingham), at 7.—A. H. Mundey: Die-Casting.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Colour Group: Informal Meeting), at 7.

INSTITUTION OF AUTOMOBILE ENGINEERS (London Graduates) (at Watergate House), at 7.25.—C. A. Partridge: Repairs.

INSTITUTION OF AUTOMOBILE ENGINEERS (jointly with Institution of the Rubber Industry) (at Grand Hotel, Birmingham), at 7.30.—A. Healey: The Mechanical Properties of Rubber.

INSTITUTION OF ELECTRICAL ENGINEERS (Dundee Sub-Centre) (at University College, Dundee), at 7.30.—A. F. Stevenson: Cable Design.

INSTITUTE OF METALS (London Local Section) (jointly with Institute of British Foundrymen) (at 83 Pall Mall), at 7.30.—D. F. Campbell and W. S. Gifford: Metal Melting by Electricity.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Tees-side Branch), at 7.30.—N. J. Lunan: Modern Constructional Steelwork.

OPTICAL SOCIETY (at Imperial College of Science and Technology), at 7.30.—J. Guild: The Insensitivity and Personal Equation Errors of Optical Settings.—*Exhibits and Demonstrations:*—Adam Hilger, Ltd.: Cylindrical Mirror corrected to give Freedom from Aberration in the Formation of an Image of a Distant Line when the Angle of Incidence is 45°.—C. Brown: Duo Chrome Sight Test.—C. W. Dixey and Son: The Maddox Cheiroscope.

INSTITUTION OF WELDING ENGINEERS (at Caxton Hall), at 7.45.—L. W. Schuster: The Fusion Welding of Unfired Pressure Vessels (Lecture).

INSTITUTE OF PATENTEES (at Caxton Hall), at 8.—Sir William A. Lane, Bart.: Inventions as an Aid to Health.

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE, at 8.15.—Prof. Warrington Yorke: Blackwater Fever.

FRIDAY, DECEMBER 13.

BIOCHEMICAL SOCIETY (at St. Bartholomew's Hospital), at 3 P.M.—H. E. Archer and G. A. Harrison: The Effect of Reaction on the Heat Test for Bence-Jones' Proteinuria.—W. H. Hurtley: Notes on the Determination of Iodine in Blood, etc.—K. V. Thimann: The Precipitation of the Basic Amino-acids of Proteins by Phosphotungstic Acid.—M. J. Rowlands and B. Wilkinson: Vitamin Content of Grass Seeds in Relationship to Manures.—A. G. Norman: The Biological Decomposition of Plant Materials.—D. R. P. Murray and C. G. King: The Stereochemical Specificity of Esterases.—H. Chick and M. H. Roscoe: Stability to Heat of Vitamin B_2 (Anti-dermatitis, Anti-pellagra).—F. K. Herbert and M. C. Bourne: The Non-Glucose Reducing Substances of Blood, with Special Reference to Glutathione.—B. W. Town: Isolation of Isoleucine from Gliadin.—H. G. Reeves and E. T. Renborn: Some Properties of Dihydroxyacetone.—J. M. Gulland and R. A. Peters: Observations on the Reducing Substances in Avian Blood.—G. Graham: The Presence of Homogentisic Acid in the Blood of Patients with Alkaptonuria.

ROYAL ASTRONOMICAL SOCIETY, at 5.—A. N. Brown: Observations of (Ch. 678) U Persei, 1924-29.—E. A. Kreiken: The Distribution of the Double Stars along the Giant Series.—J. G. Hagen: On the Significance of Baxendell's Nebulosity.—H. G. Tomkins: Three Features of the Lunar Crust, from Photographs taken at Dedham.—Dr. H. Spencer Jones and J. W. Jackson: Stellar Parallaxes Determined Photographically at the Cape Observatory (2nd list).—W. S. Franks: Visual Observations of Dark Nebulæ.

PHYSICAL SOCIETY (at Imperial College of Science and Technology), at 5.—J. H. Awbery and Dr. Ezer Griffiths: Apparatus for Determining the Specific Heat of a Material in Powder Form.—Dr. W. E. Deming: On the Determination of the Parameters in an Empirical Formula.—N. S. Alexander: The *J*-Phenomenon in X-Rays.

MALACOLOGICAL SOCIETY OF LONDON (in Zoological Department, University College), at 6.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Prof. G. F. Charnock: Bearings for Power Shafting.

TEXTILE INSTITUTE (London Section) (at Chemical Society), at 6.45.—A. E. Woodhead: Commercial Application of the New Esterified Cotton Fibres.

OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at Milton Hall, Manchester), at 7.—Dr. Stern: Fastness to Light.—C. D. O. Winslade: Some Aspects of Colour Testing.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Informal Meeting) (at Newcastle-upon-Tyne), at 7.15.—E. Wilson and others: Is Sea Experience essential in order to become a Good Marine Engineer?

JUNIOR INSTITUTION OF ENGINEERS (at Royal Society of Arts), at 7.30.—Sir Ernest W. Moir, Bart.: Some Engineering Difficulties and how they were overcome (Presidential Address).

LEICESTER TEXTILE SOCIETY (at Victoria Hall, Leicester), at 7.30.—E. J. Spurr: The Dyeing and Finishing of Hosiery Fabrics.

INSTITUTE OF METALS (Sheffield Local Section) (at Sheffield University), at 7.30.—Prof. F. C. Lea: Physical Testing.

INSTITUTE OF CHEMISTRY OF GREAT BRITAIN AND IRELAND, at 8.—Dr. L. H. Lampitt: The Chemist and Commerce (S. M. Gluckstein Memorial Lecture).

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Miss D. A. E. Garrod: Cave Excavation in the Near East.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at St. Thomas' Café, Swansea).—E. A. Tyler: Pure Chemicals.

SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (jointly with Manchester Literary and Philosophical Society: Chemical Section) (at Manchester).—C. Hollins: Patent Law in Relation to the Dyestuffs Industry.

SATURDAY, DECEMBER 14.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (at Newcastle-upon-Tyne), at 2.30.

PHYSIOLOGICAL SOCIETY (at St. Thomas's Hospital).

PUBLIC LECTURES.

SATURDAY, DECEMBER 7.

MATHEMATICAL ASSOCIATION (London Branch) (at Bedford College), at 3.—Prof. H. Levy: Dimensional Theory as a School Subject (Presidential Address).

HORNIMAN MUSEUM (Forest Hill), at 3.30.—M. A. Phillips: British Wild Life off the Beaten Tracks.

MONDAY, DECEMBER 9.

LONDON SCHOOL OF ECONOMICS, at 4.30.—E. H. Warmington: The Debt of Medieval Explorers to Ancient Discoverers (4): Asia.

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY (Royal College of Science), at 5.30.—Dr. D. A. Allan: Rocks as Records of Earth History (Swiney Lectures). (Succeeding Lectures on Dec. 11, 13, 16, 18, 20, Jan. 20, 22, 24, 27, 29, 31.)

TUESDAY, DECEMBER 10.

TECHNICAL COLLEGE, CARDIFF, at 7.30.—Dr. J. H. Quastel: The Search for Drugs to cure Disease.

UNIVERSITY OF LEEDS, at 8.—Dr. J. S. Anderson: Infection.

WEDNESDAY, DECEMBER 11.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Prof. Winifred Cullis: Speed as a Psycho-Physiological Factor in the Life of To-day.

ROYAL ANTHROPOLOGICAL INSTITUTE (at Portland Hall, Great Portland Street Extension of Regent Street Polytechnic), at 5.30.—Prof. F. G. Parsons: The Anthropological History of the Modern Englishman.

SATURDAY, DECEMBER 14.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss M. A. Murray: Witchcraft.

EXHIBITION, ETC.

DECEMBER 6.

BRITISH INSTITUTE OF RADIOLOGY INCORPORATED WITH THE RÖNTGEN SOCIETY (at Central Hall, Westminster).

10.30 A.M. to 12.30 P.M.—W. E. Schall: A Single Valve Plant for Diagnosis and Deep Therapy.—Cuthbert Andrews: A Mobile X-ray Unit.—Dr. Ffrangcon Roberts: Modern Radiological Developments in Germany with Special Reference to the New Institute at Frankfurt.—Dr. A. Orlansky: Output of Transformers under Different Methods of High Tension Rectification.—W. R. Gray: A Hot Cathode Tube with Rotating Anode.—Dr. E. J. H. Roth: The Mekapion, an Ionisation Apparatus for the Absolute Measurement of X-ray Dose.

At 2.30.—Miss S. F. Cox and F. G. Spear: Tissue Culture and its Application to Radiological Problems.—Miss S. F. Cox: The Action of X-rays on Living Cells Cultivated *in vitro*.—Dr. F. G. Spear: The Immediate and Delayed Effects of Radium on Tissues Cultivated *in vitro*.

CONFERENCE.

DECEMBER 6.

INSTITUTION OF CHEMICAL ENGINEERS (at Chemical Society).—Vapour Absorption and Adsorption.

At 10.30 A.M.—A. Hoch: The Recovery of Volatile Solvents (Brégeat Process).—J. S. Morgan: The Continuous Fractionation of Gases by Adsorbents.

At 2.30.—G. W. Himus: Evaporation of Water in Open Pans.—K. Evans and H. F. Pearson: The Industrial Application of Active Carbon.